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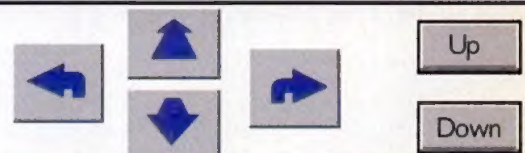
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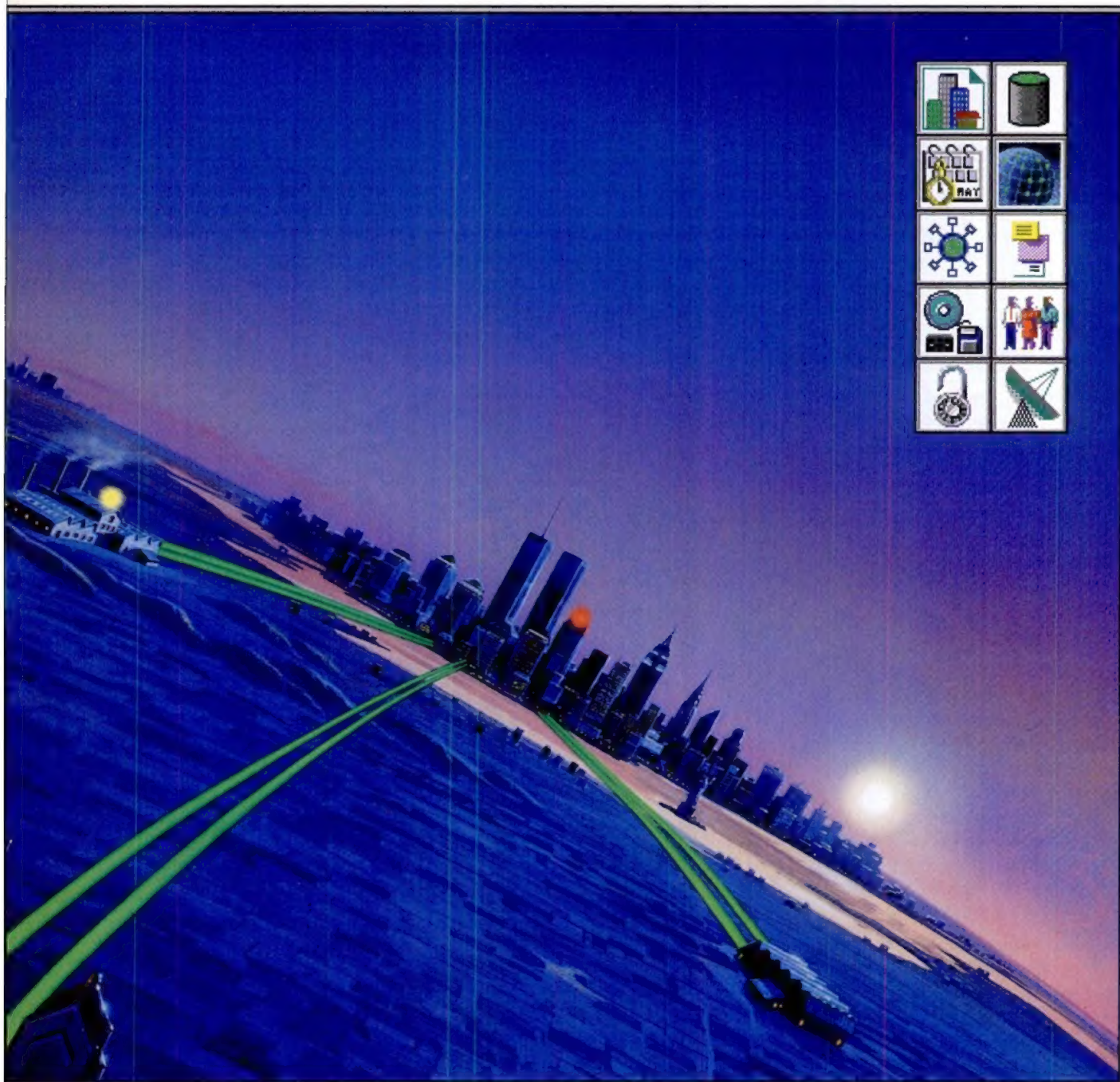
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Inside

Coming soon to a small screen near you: World Wide Web presentations of full-motion video and CD-quality audio, all in real time. But hold the popcorn for now.

Among the many promises of the Internet is that someday your PC and Web

connection may take the place of your telephone, television, VCR, CD player, and videoconferencing room. Someday perhaps, but today, with a few exceptions, the multimedia paradigm for the Web is download and play later. The good news is that the exceptions are rapidly growing in num-

es and the many different Web browsers with which the products have to be compatible. Above all, the low bandwidth that characterizes most Web connections and the lack of Internet standards for audio and video compression mark Internet multimedia as a nascent art form.

We asked our Internet team, led by senior editor Tom Mace and project leader Jay Munro, to sort out this welter of technologies and products. The team pulled most of the available video and audio products for the World Wide Web into PC Magazine Labs for tests and analyses that combined ob-



jective lab routines with subjective "jury testing."

As you would expect from the current state of Internet technology in general, these applications come from a wide number of companies, many of them small startups rushing to take advantage of the explosive growth of the Internet.

Their products face significant roadblocks to widespread commercial acceptance, particularly their proprietary approach-

As you'll discover in the resulting article, "Live From the Web," our investigation found exciting progress being made toward meeting the promise of real-time Web-based multimedia. We also found that the technology is still in the early stages of development.

For now, hang on to your TVs, VCRs, and CD-players. But stay tuned to the Web, where the best is yet to come.

—Jake Kirchner

PC Magazine, ISSN 0888-8507, is published twice a month except in July and August, for \$49.97 for one year. Ziff-Davis Publishing Company, L.P., One Park Ave., New York, NY 10016-5802. Second-class postage paid at New York, NY 10016-5802 and at additional mailing offices. POSTMASTER: Address changes to PC Magazine, P.O. Box 54093, Boulder, CO 80322-4093. GST registration number: R-123669673; in Canada, R140496720. Canada Post International Publications Mail Product (Canadian Distribution) Sales Agreement No. 266477.



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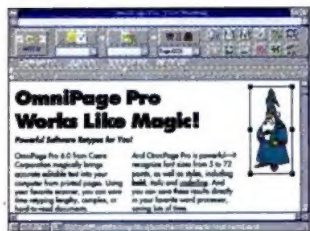


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UP FRONT

Inside

Two thumbs up4

Letters

Word processors with the works19

Trends

- ▶ Intel's 1996 road map
- ▶ Microsoft's Net strategy
- ▶ Credit cards on the Net
- ▶ New telecom rules
- ▶ Intranet boom31

Pipeline

Novell to WordPerfect
Users: Drop Dead!32

First Looks

- ▶ Fractal Painter 4.0
- ▶ [LapLink for Windows 95](#)
- ▶ 150-MHz Pentium OverDrive processor
- ▶ HP ScanJet 4P39

Second Looks

PageMaker 6 and ODBC73

COLUMNISTS

Michael J. Miller

From the Editor-in-Chief29

Bill Machrone

When It's Finished85

John C. Dvorak

In the Wake of
Windows 9589
Inside Track91

Jim Seymour

Kids and Computers:
A New Paradigm93

Bill Howard

Home Sweet PC95



NEC MultiSync LCD200:
The thinnest monitor (page 69).

COVER PHOTO BY THOM O'CONNOR

COVER STORY

Internet

Audio... Video... LIVE FROM THE WEB!



BY JAN OZER Whether it's speech, music, video, animation, or all of these, multimedia is the most exciting trend on the World Wide Web today. If you're an end user, it brings an immediacy to the Web that plain HTML text just can't match. If you're a site manager, it's the quickest way to attract and keep an audience that's always just a click away from someone else's site. We test the leading streaming audio and video technologies from VocalTech, Progressive Networks, Xing Technology, Voxware, The DSP Group, and VDONet to show you how they work, which tasks each product handles best, and what it takes to get them up and running.....100

SOUND BLASTS THE WEB103
Internet Wave 1.0.....108
ReadAudio 2.0.....113
StreamWorks.....118
ToolVox for the Web.....122
TrueSpeech Internet.....125
How We Tested
Streaming Audio.....104
Editors' Choice.....105
Summary of Features.....128

WEB TV TUNES IN129
StreamWorks.....134
VDOLive.....136
How We Tested
Streaming Video.....131
Macromedia's Shockwave for Director.....135
Apple's QuickTime VR: Almost Virtual Reality.....136
Internet Phones and Videoconferencing.....143

PCs

Server Power

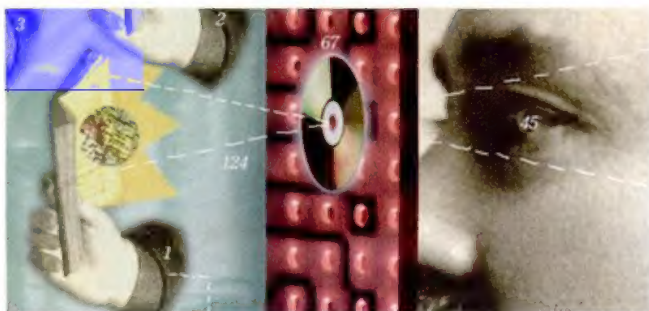
BY PADRAIC R. BOYLE Today's high-capacity, departmental-level file servers are breaking new price/performance ground as well as offering a total, networkable solution to the potential buyer. In this roundup, we look at departmental file servers from six of this market's leaders. We evaluate them based not only on performance but also on expandability and scalability, fault tolerance and security features, and the quality of the vendors' server management solutions. We run these file servers through their paces over a Fast Ethernet network, gauging performance with our NetBench 4.0 benchmark tests, under both Windows NT Server 3.51 and NetWare 3.12146

Compaq Computer Corp.	159	The Rest of the Story: Windows	
Dell Computer Corp.	162	NT 3.51 Server Performance ...	161
Digital Equipment Corp.	166	Network Testing	164
Hewlett Packard Co.	170	Performance Tests	168
IBM Corp.	178	Summary of Features	175
IPC Technologies Inc.	182	The Pentium Pro: Big-League	
Editors' Choice	149	Processing Muscle	182
Suitability to Task	150	Microsoft File and Print	
1995 U.S. Server Shipments	154	Services for NetWare	184
Price/Performance Index	159	RAIDers of the Lost Drive	188



PC Magazine At Home

Multimedia Encyclopedias: Just the Facts?



BY SHANE MOONEY It's time to find out whether or not that PC of yours is really any help with the kids' homework—or with any serious research you may want to do. To answer that question, we tested six Windows-based multimedia encyclopedias and rated each in terms of content, multimedia offerings, and online connectivity. We also looked at six history and geography titles to give you a glimpse into the wealth of reference material available on CD-ROM.....305

Britannica CD	309	Microsoft Encarta 96	
Compton's Interactive		Encyclopedia	318
Encyclopedia, 1996 Edition	310	1996 Grolier Multimedia	
Encyclopedia Americana	312	Encyclopedia	324



World Book Multimedia		Reading the Report Card	310
Encyclopedia	327	Digging Deeper:	
The Good, the Bad, and ...	308	History	315
Editors' Choice	309	Geography	321

PC TECH

Promise Fulfilled: DB2 for Windows NT

BY BRIAN BUTLER A new heir to IBM's venerable relational database dynasty breaks with tradition and comes out a star.....190

Tutor*

BY JEFF PROSISE One for the little guys: Three diminutive utilities that can save you time and frustration.....201

Power Programming*

BY JEFF PROSISE Using versionable schemas in MFC 4.0.....205

Internetworking

BY SEAN GONZÁLEZ Streaming audio on the Web.....209

Utilities*

BY TOM RAWSON Find lost files and text anywhere on your disk with WSEARCH.....213

PC SOLUTIONS

User-to-User*

BY NEIL J. RUBENKING Using long filenames with old programs; exiting from Windows 95 to DOS; detecting Windows and Windows 95 from a batch file.....223

Hardware

SIMM converters let you combine smaller-capacity SIMMs into a larger-capacity unit; why you may not be getting the full CPU speed of an upgrade chip; determining the capacity and rating of a SIMM.....228

Operating Environments

When your Windows 3.1 load= line is too long; Internet access problems in OS/2; deleting mangled icons.....234

Word Processing

Canceled background printing in Microsoft Word 6 and 7.....240

Spreadsheets*

Prompting for user input in a Microsoft Excel macro.....246

Databases*

A FoxPro function that determines the number of days in any given month; Visual FoxPro lacks its predecessor's Beautify function: here's how to restore its functionality.....252

AFTER HOURS

Abort, Retry, Fail?

BY DON WILLMOTT.....338

NETWORK EDITION

Follows page 96

Cover Story

Client/Server Demystified

BY DAVID S. LINTHICUM We'll get you past all the buzzwords and market hype to understand how client/server breaks out into five major product areas. We'll help you decide whether it's right for your business—or overkill.....NE1

First Looks

- Cruiser 1.1.....NE29
- Virtual Desk PC.....NE29
- PhoneWorks 28.8.....NE30

Multiple Access

BY ROBERT P. LIPSCHUTZ
Turtles, Snails, and Your PC.....NE34

New & Improved

BY ERYN BROWN.....NE37

ALSO IN THIS ISSUE

PC Direct.....	223
Marketplace.....	271
Premier.....	271
Classified.....	287
BusinessCard.....	301
Reader Service Card.....	280
Advertisers' Index: Companies.....	333
Advertisers' Index: Products.....	334
Coming Up.....	336
Editorial Product Index.....	337



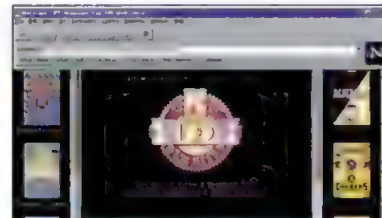
IBM's new DB2 for Windows NT (page 190).

PC MAGAZINE BEYOND PRINT



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Are you adrift on the Web sea, hoping to wash up on a site that quenches your thirst for information? Well, set sail for *PC Magazine's* top 100 Web sites. This friendly port of call has maps to the best the Web has to offer. Find out what our experts consider the best Web sites for such subjects as Internet Resources, Computer Resources, Commerce, News and Sports, Government, Reference, Education, and many others.



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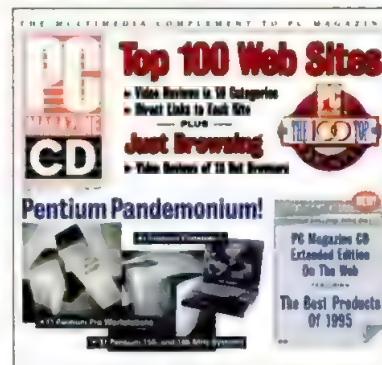
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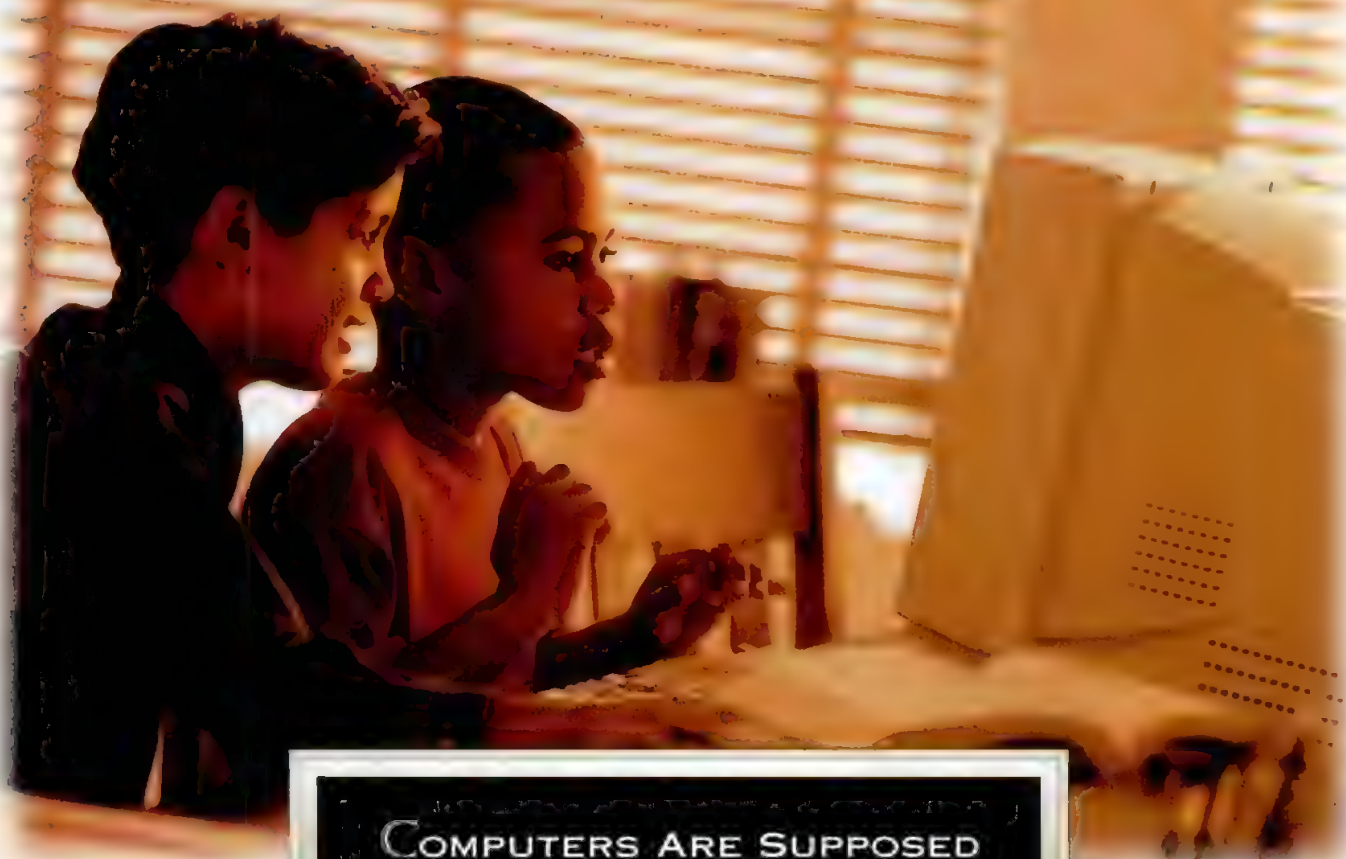
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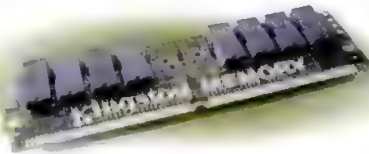


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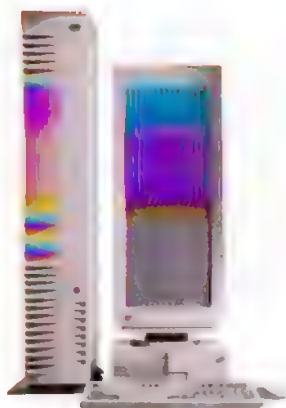
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~~CLICK.~~ average, it takes about eleven
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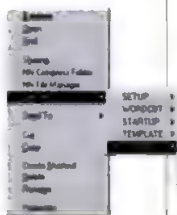
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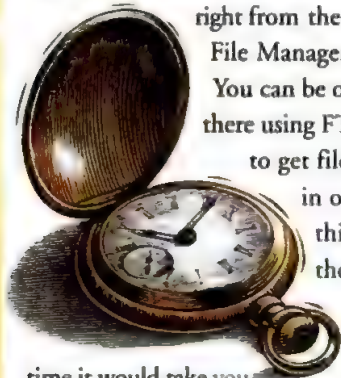
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PC Magazine, Editors' Choice, 11/21/95

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Letters

BELLS AND WHISTLES

I just finished your cover story on word processors ("Word Processors: Front & Center," November 21, 1995). Though I found your discussion of the vast technical capabilities of these products very informative, I believe you skipped over other very important considerations. How easy is it to type and edit text, for example? How bug-free is the product? How much memory and storage space does the product use? How good is the customer support? What I'm suggesting is that you could do a more valuable service for your readers by providing them with all the information, not just the bells-and-whistles stuff.

JAMES J. PELOUCH, JR.
Strongsville, Ohio

In your cover story on word processors, your review of WordPerfect 6.1 for DOS is too generous. Release 6.1 runs slower than 5.1, and its new features are not significantly better. *PC Magazine* is a great magazine that I enjoy, but WordPerfect 6.1 is no great improvement.

JIM GRIFFIN
Rio Rancho, New Mexico

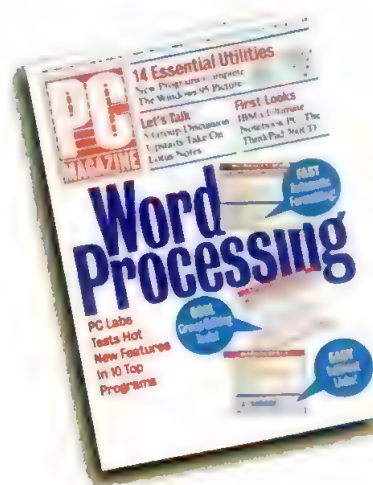
It's a sad commentary indeed when a major article on word processors fails to mention the word processor that started it all and that continues to be used by millions of writers worldwide: WordStar. In a world dominated by feature-heavy, overblown applications that have forgotten their original purpose, WordStar 7.0D for DOS stands out for its ability to put words on the page faster and edit them faster than any other word processor. I'm not living in the past, but to talk about Clearlook for OS/2 or Describe yet fail even to mention the original is at the least bad manners, and at the most bad reporting.

JOHN P. BOYLAN
via *PC MagNet*

I've just finished reading your article on word processors and have been left bewildered. Amid all the discussion of bells and whistles, I fail to find an evaluation of my most important requirement: a word processor that will let me touch-type and edit on the fly. That's the reason I'm still using WordStar 3.3. Which one of the programs you reviewed would allow me to do what I already do so easily with my "antique" word processor?

JOSEPH AMIEL
via the Internet

Finally, a survey of today's major word processors. . . and lo and behold, even Lotus Ami Pro, the regularly unmentioned "phantom" word processor, was accorded a full review. As dearly welcome as your reviews are,



*All frills aside, we
just want a word processor
that meets our needs.*

I heartily disagree with your awarding the laurels of an Editors' Choice distinction to WordPerfect 6.1. While 6.1 may have oodles of bells and whistles and all kinds of fancy features, I've found working with it to be total and unrelenting frustration.

PETER H. WEISS
Vancouver, British Columbia

Your recent review of word processors was discouraging. The statement that the overall feel of Lotus Word Pro is "slightly sluggish" was particularly scary. One might expect things to be optimized over time, but is that the priority for Lotus, when the Windows 95 version is still being worked out? So let's see, the smoother and quicker version might debut sometime in the fourth quarter of 1996. Until then, if you want Word Pro, apparently the only little compromises are that it is slow and buggy. I frankly wish that there were an objective measure of incremental productivity to judge some of these trade-offs. What kind of progress is it when useful features (speed not derived entirely from processors and memory chips, for example) give way to niche features? What kind of progress is it when the evolution of operating systems is systematically eliminating entire families of software with the precision of a death camp?

GEORGE B. SEARS
Cedar City, Utah

TOPSY TURVY

I wish to take exception to the reference "grew like Topsy" in Bill Machrone's column, "Topsy and the Internet" (November 21, 1995). I don't know where you got your

story, but I am sure that the correct reference should be to the tale of Topsy's life in *Uncle Tom's Cabin* by Harriet Beecher Stowe, in which the child is referred to as just having "grewed." This was a great American novel that significantly affected the course of slavery in this country; I hope that you will be able to correct the injustice done both to the author and to the character.

CHARLES S. YOUNG III
via *PC MagNet*

The opening paragraph of the article "Topsy and the Internet" contains a serious literary error. But this astounding bit of misinformation didn't spoil my enjoyment of your interesting article. Such articles are of special interest to me because I live and work in Salalah, in the Sultanate of Oman, where I follow my hobby of computing under great difficulties. As far as the Internet is concerned, it is still a dream for us here—our only discoverable contact with the outside world is through CompuServe. Maybe one day we, too, will have modern communications for computer users, but until then, I will have to use your articles as a basis for my dreams.

MICHAEL BURCH
via *PCMagNet*

Bill Machrone should be taken out and beaten with a library card for his pathetic explanation of Topsy.

J. AGNEW
via the Internet

I 'spect Bill Machrone forgot all about Uncle Tom, Little Eva, and tatterdemalion Topsy, who said she "never had no father, nor mother, nor nothin'." I was raised by a speculator. . . I 'spect I grewed." There may very well have been a racehorse named Topsy, but it sure didn't help start the Civil War as Harriet Beecher Stowe did with *Uncle Tom's Cabin*.

BRAD O'HEARN
via *PC MagNet*

I sincerely hope my cynicism about current educational standards is misplaced and that you have already received hundreds of comments on Machrone's article. But just in case, please ask him to check out *Uncle Tom's Cabin* to find the source for Topsy—his racehorse allusion is totally off. Topsy was one of the young slave girls, who didn't know who her parents were or how old she was—she just "grewed."

STEVE ESTVANIK
via *PC MagNet*

SETTING THE RECORD STRAIGHT

In his latest article ("Microsoft Under Fierce Attack," November 21, 1995), John

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Letters

C. Dvorak gives the impression that all members of Team OS/2 are "subversive and vigilante-like." I would like to set the record straight. I will agree that some of the Team OS/2 members are exactly as Dvorak has described them, but many of us promote OS/2 in very positive ways, such as doing demos at users' groups and local computers stores for free. So the next time you write an article on Team OS/2, John, don't forget to show both sides of the story.

BILL HEMENWAY
via the Internet

Either Dvorak needs a little clarification of what Team OS/2 is or I've missed something. I don't ever recall reading messages telling me how to destroy Microsoft. And the last time I read the Team OS/Newsletter I didn't see any tips on how to make a Windows advocate look like a fool. Team OS/2 was set up to help OS/2 users and spread OS/2 awareness, but Team OS/2 has absolutely nothing to do with Microsoft or Windows 95. Some OS/2 users do take potshots at Windows 95; some Team OS/2 members do the same, as do some Windows 95 users. Don't generalize about a group of people, Mr. Dvorak; it is unkind and incorrect.

VANCE PALODICHUK
via the Internet

No doubt Microsoft owes its success to copying ideas from IBM, but in this case, the ClubWin idea originated elsewhere. In fact, the basic concept was born on one of the beta forums and subsequently proposed to Microsoft, which was enthusiastic about it. Forum members wanted to stay in touch after the release of Windows 95 and thought such a group would be a great way to help each other as well as anyone else who needed it.

JOHN WORAM
via PC MagNet

TRENDS REVISITED

Sebastian Rupley's profile of Internet users ("Do You Fit the Internet Profile?," November 21, 1995) proves you can make numbers say anything you want. He states that the largest age group of users is 35- to 44-year-olds at 25 percent. Actually, the pie chart graphic in the article indicates that the largest group of users is those age 25 to 34 at 35 percent.

MARK L. LANGEVIN
via the Internet

The article "Pentium Pro Repositioned" (Trends, November 21, 1995), while objective, points to the Pentium Pro as a disap-

CORRECTIONS AND AMPLIFICATIONS

In our recent Pentium notebook roundup ("On the Road with the Pentium," January 23, 1996, page 100), we incorrectly described Maxtech Corp.'s X-751C Yesbook as a 100-MHz Pentium notebook, when actually it runs on a 90-MHz Pentium processor. The price listed, \$2,595, is correct.

In a First Looks article ("Getting into the Act: Banking Software," January 23, 1996, page 332), we misidentified the graphic as being from Citibank's Web page, when in fact it was from Security First Newtwork Bank (<http://www.sfnb.com>).

Contrary to what was stated in the write-up of the Citizen Printiva 600c printer (New & Improved, January 23, 1996), the black replacement cartridge costs \$6.49, and the cyan, magenta, and yellow cartridges cost \$7.99 each (see the full review in the First Looks section of this issue).

pointment. The truth is that Windows 95 is the real disappointment. It lacks the ability to use fully the awesome power of the Pentium Pro. Microsoft knew well in advance that the Pentium Pro CPU was to be a true 32-bit chip; Intel certainly made it no secret. Yet Microsoft went ahead and made Windows 95 with dollar signs in its eyes and no commitment to the future. *PC Magazine* should be more concerned with Microsoft's flawed OS than with companies like Intel that are moving us forward rather than holding us back.

BREEN C. OUELLETTE
Prince Albert, Canada

WEB WORDS

Michael J. Miller misses the point in his article "Casting a Net Beyond HTML" (November 21, 1995) when he talks about portable viewing documents on the Web. "Portable" document viewing, along with hypertext linking, is the entire point of the World Wide Web. In order to achieve this end, we use HTML, which limits the formatting available in a document. People who attempt to republish paper magazines on the Web find this a limitation, because they fail to understand that the most innovative work on the Web is not dependent upon HTML extensions (which control formatting). The most innovative work is concentrated in projects like Lycos, Yahoo, World Wide Web Worm, and other cataloging and sifting tools in creation. These tools help people find information on the Web—which is what it was intended for.

JONATHAN LASSER
via PC MagNet

TALKING PC TECH

I wish to pass on a thank you and a compliment on a trend I have noticed in several of your articles lately. The most recent example is the PC Tech/Tutor article "What's in a Thread?" by Jeff Prosis (December 5, 1995). The article explains concepts and methods very clearly, without assuming that the reader already understands a term or the basic operations of a complex technology. So many articles I have attempted to read in the past start out simply for the first two paragraphs, then seem to be missing four paragraphs as they jump over definitions and into material that seems to assume a

background in electrical engineering. Keep up the good work.

RICHARD KESSLER
via PC MagNet

Thank you for your excellent article explaining multithreading in layman's terms. I will share this article with my clients who are moving to OS/2, Windows 95, or Windows NT.

JOHN A. JACKSON
via PC MagNet

I greatly enjoyed reading "What's in a Thread?" in the PC Tech/Tutor section. Deep down, whether or not we admit it, we are all kids. The younger ones play games on computers while the rest of us, the grownups, just play with our computers. We get enjoyment out of installing different programs and occasional peripherals. We read tips on how to fine-tune our computers and operating systems. It's nice to know that *PC Magazine* understands and accommodates this portion of its readers. Nothing fits the bill for us better than the PC Tech/Tutor column. *PC Magazine* isn't a magazine for kids, but it is a magazine that can reach out to the kid in all of us.

YORAM ADLER
Brooklyn, New York

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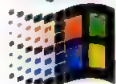


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Three computer setups are arranged vertically. The top setup is a Windows 95 desktop with the logo on the screen. The middle setup is a DOS desktop with the 'DOS' logo on the screen. The bottom setup is an OS/2 desktop with the 'OS/2' logo on the screen.

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The Web Wore Black

February 8, 1996. It was supposed to be a day of celebration on the Internet: the day chosen to record "24 Hours in Cyberspace," a documentary of online computing organized by Rick Smolan, best known for the *Day in the Life* series of coffee-table

books. Indeed, the project, which was posted on the Cyber24 World Wide Web site (<http://www.cyber24.com>), showed us some wonderful and fascinating uses of Internet technology—from Michigan schoolchildren taking part in an archaeological dig in Egypt, to the Aspen hack whose cab is hooked into the Net via a cellular modem, to the CyberPub in Bangkok.

Elsewhere on the Internet, the mood wasn't so joyful. *PC Magazine*, along with thousands of other Web sites, changed its background from white to black. Other sites wore blue ribbons. These weren't fashion statements; they were protests against a provision of the Telecommunications Act, which President Clinton signed into law the same day. A lot of people, especially those in the telecommunications industry, cheered the signing of this bill, which clears the way for more competition among providers of telephone, cable, and computer services.

But free speech advocates were outraged by a part of the bill called the Communications Decency Act, which makes it a federal crime to publish "obscene or indecent" material that could be seen by minors. As I've discussed in previous columns (such as "Cyber Censors," February 20, 1996), I understand the intentions behind this act because some of the material on the Internet is not appropriate for minors. Still, this is the wrong solution. The language in this bill is too broad, too ambiguous, and possibly unconstitutional. Instead of government regulation, I'd like to see content providers adopting technological solutions that restrict access to sites that are not appropriate for minors.

The reaction to the Communications Decency Act by the Internet community and free speech groups was swift. Voters Telecommunications Watch (<http://www.vtw.org>) and the Electronic Frontier Foundation (<http://www.eff.org>) organized online protests while the ACLU immediately vowed to challenge the provision in court. Even normally probusiness groups like the Software Publishers Association protested the restrictions.



INTERNET LOST

Those active in building the Net have promoted a utopian view of its promise.

Back to reality, folks.

Other groups complained the telecommunications law would lead to a ban of online distribution of abortion information, although that is not directly mentioned in the bill and supporters of the new rules said that wasn't the intent.

Many of the people who have been most active in building the Internet have promoted a utopian view of the Net and its promise for humanity. They have believed it would enable everyone to become a publisher, break down barriers, and build a better world. Some have even gone so far as to say "information wants to be free."

Back to reality, folks. Computer technology offers tremendous benefits, and I believe it is changing the world in dramatic ways. But it isn't a panacea: People are still people, and computer technology has as much power to do evil as it has to do good. Every one of us should be cautioned by the all-too-true stories of bomb plans posted on the Internet and of people who prey on children and teens in online chat rooms. Although I believe there are better solutions than legislating online content, I am concerned about these threats.

People tell me I shouldn't worry about government actions. The government doesn't really matter any more, they argue, because we'll always develop technology to circumvent government restrictions. Anyone who truly wants access to information will find a way to get it. What I am concerned about is that the potential of the Internet as a worldwide communications infrastructure will be jeopardized if countries set individual restrictions. And I'm worried those restrictions will open the door for more limitations on free speech.

Whatever happens, February 8, 1996, will go down as the day the Internet lost its innocence. It will continue to grow and evolve—eventually into something far different from what we see today. We'll continue to see new technologies, new sites, and new applications. We'll meet people, exchange information, and even do business on the Net. But the Internet will never be young again. □

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Trends

TRENDS & TECHNOLOGIES SHAPING THE PERSONAL COMPUTER MARKET

Intel's Road Map

Speeding up to Pentium/200s and 32-bit apps.

Better-than-expected manufacturing yields and signs that businesses will migrate to 32-bit platforms this year have prompted Intel to revise expectations for its processor lineup in 1996.

The company predicts that Pentium Pro systems will proliferate on business desktops this year, while 200-MHz Pentiums and multimedia enhancements will appear on home PCs before the end of the year.

The latest projections differ markedly from predictions Intel made just a few months ago—largely because of higher-than-expected yields from its 0.35-micron manufacturing process. “We’ve never been able to deliver technology in processors as fast as we have in the past two years,” says Carl Everett, senior vice president of Intel’s desktop products group.

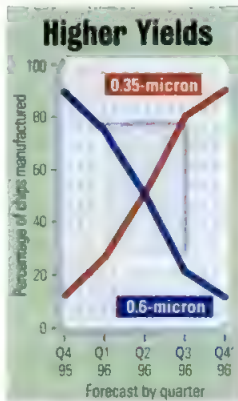
At the same time, sales of Pentium Pro systems, which have lagged because of marginal performance gains with existing 16-bit apps, are expected to pick up in 1996 as companies switch to Windows NT—a native 32-bit operating system—and prices decrease. Though corporate America retains a large installed base of 486 PCs, Everett says businesses are on the verge of migrating to 32-bit software, where Pentium Pro chips excel.

“We’re at a very interesting time because that base is ready to be replaced,” Everett says. “When they choose NT, we think they’ll do the right thing and choose Pentium Pro.” By the fourth quarter, the 180- and 200-MHz Pentium Pros will form the core of Intel’s mid- and high-performance business line. More than 30 PC manufacturers have announced Pentium Pro machines, according to Intel.

For users still wed to their 16-bit apps, Intel plans to ship in 200-MHz Pentium processor this year. The current midrange Pentium/120 and Pentium/133 will become entry-level by year’s end.

In addition to the Pentium/200, the P55C chip, a Pentium with Intel’s multimedia extensions, will appear on high-end home PCs costing more than \$3,000 by the fourth quarter and on business PCs in mid-1997. Intel says the P55C will deliver significant improvements in video and audio.

What does all this mean for consumers? Businesses can expect 200-MHz Pentium Pro systems for less than \$2,500. And by the holiday season, home buyers will be able to get today’s top-of-the-line Pentium/166 PC for about \$2,000, according to Intel. Both products will feature new chip sets, a Universal Serial Bus, and built-in Internet features.



Despite ambitious plans for the Pentium Pro and P55C, Intel could be ripe for a slowdown. Among the reasons: The Pentium/200 is expected to offer only minor performance gains over the Pentium/166, and Intel’s multimedia technology could be a case of too

little, too late, says Linley Gwennap, editor-in-chief of *Microprocessor Report*. “The pace of innovation has slowed dramatically,” he says, adding that 1997 could be a more exciting year for Intel as home consumers enter the Pentium Pro arena.—John Morris

Microsoft's Internet Strategy: Free Stuff

Microsoft unfolds aggressive Internet plans.

If there’s so much money to be made on the Internet, then where’s Microsoft? Its Internet strategy has been somewhat delayed, but it plans to release an onslaught of products geared primarily for developers of in-house corporate networks or intranets.

For starters, Microsoft is bundling its Internet Information Server with Windows NT—which will compete directly with Netscape Communications Server. And Microsoft’s Web site is offering downloadable tools for writing Web applications, including VB Script, a network-secure subset of Visual Basic that will compete with Sun Microsystems’ Java. VB Script has a smaller runtime module than Java (50K versus 1.2MB), which means there’s less data to download, and it’s based on the familiar Visual Basic syntax rather than Java’s C++-style syntax.

Another freebie is the Internet Control Pack, a set of OLE controls for creating Web browsers, news readers, and ftp software. And an upcoming version of Microsoft Foundation Classes—an interface that developers use to write Windows apps—will make the Internet easily accessible to C++ developers. Enhancements to Visual FoxPro and Microsoft Access will also let developers store databases on the Web.—Sheryl Canter

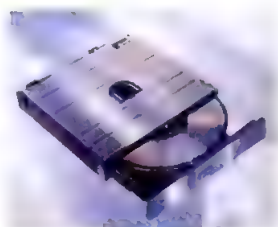
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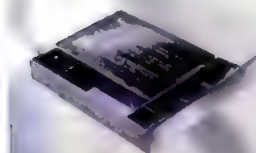


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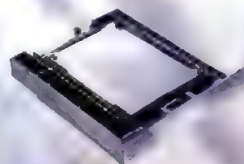
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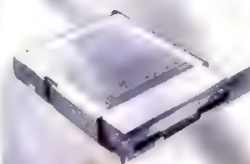
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MasterCard and Visa Join Forces for Net Commerce

You, too, can spend more money on Net shopping sprees.

In a major step toward the era of global electronic commerce on the Internet, MasterCard and Visa have agreed to develop a joint technical standard for safeguarding credit card purchases made over the Internet. The new specification, called Secure Electronic Transactions (SET), is based on encryption technology from RSA Data Security of Redwood City, California. According to RSA's president, Jim Bidzos, "This is a giant step toward the globalization of electronic commerce, and one that virtually guarantees international standards."

The two credit card giants had previously pursued different standards, and the list of other warring standards in the all-important race toward secure electronic commerce had read like alphabet soup: Microsoft pushed its SPP, IBM offered SEPP



(based on IBM Zurich's IKP), Netscape had Secure Courier, and Digi-Cash and Spyglass had others. While these specifications haven't gone away, support for SET is gathering significant momentum.

"SET is based on RSA encryption," says RSA's Bidzos, "which has been the one and only common element in Microsoft's, Netscape's, and IBM's approaches to secure electronic payments. SET looks like it has the backing of the International Standards Organization (ISO), which means it promises to be an international standard."

The list of companies supporting SET reads like a technology who's who: GTE, IBM, Microsoft, Netscape, SAIC, Terisa Systems, and Verisign. The joint specification is scheduled for testing in the second quarter of 1996, and the two companies expect that banks will offer secure bank-card services via the Internet to their cardholders in the fourth quarter.

RSA's Bidzos warns that "there's still the issue of getting the right implementation of these security standards." RSA expects to release a toolkit

soon for uniformly implementing SET. He says that this should ensure that weaknesses in implementation, such as making it easy for somebody to extract a password, are minimized.—Sebastian Rupley

Aggressive Adaptation Is Key to Online Services' Survival

Online services strategize anew in the Internet's wake.

Some industry observers predict that traditional online services will drown in the wake of the ever-expanding Internet. But the big-three services say they are aggressively adapting to upheaval in the online world and will continue to compete effectively with the many smaller Internet service providers who offer Internet access, often at lower

prices than online services.

The online services, along with the largest BBS providers, are competing with Internet service providers on multiple fronts. They offer subscribers complete Internet access, alongside diverse and highly organized proprietary content. "Proprietary services like CompuServe bring order to the chaos," says Giles. "Our service is

structured," he adds, "while the Internet is a conglomeration of servers." Giles says the service currently adds 200,000 to 250,000 new subscribers per month. New subscriptions jumped 40 percent in the first week of January, compared with a typical week last December, but Giles concedes this may have been a temporary spike due to the holiday season.

CompuServe targets inexperienced new users with Project Wow!, a new online service set to debut in 1996. Project Wow! will offer home users consumer- and life-style-oriented content and an emphasis on ease of use. CompuServe also operates a separate Seattle-based Internet division that provides Internet access to 100,000 subscribers.

"We're using the Web in judo-like fashion," says Josh Grotstein, senior vice president of content at Prodigy. "Instead of letting it crush us, we're using its size to make us more powerful." He notes that the online services offer some features not yet available on the Internet, such as a se-

cure environment for online transactions. "The Internet is still in the 'if you build it, they will come' stage. But the online services have been generating revenue in these ways over the last few years," he points out.

Prodigy will begin market trials for a separate Internet access service on March 19, with plans to go nationwide in the first half



STRUCTURE AND ORDER: Subscribers continue to flock to the highly organized online services.

of 1996. In the meantime, Prodigy, like the other two major services, offers Internet access from within its proprietary interface. That interface has been largely rewritten in HTML code, Grotstein reports, to give Prodigy the look and feel of the Web, and to let content providers develop for both the Web and Prodigy.

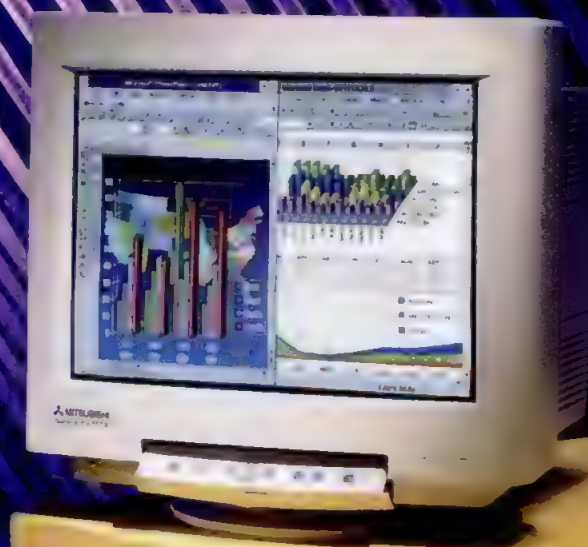
—Jonathan Karl Matzkin

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Source: PC Data. Data for December 1995. Additional lists at <http://www.zdnet.com/pcmag/topstory/topsten.htm>

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Will an ORB Light Your Network?

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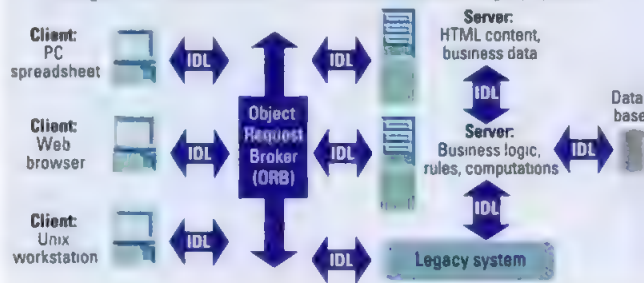
Just as Microsoft's object linking and embedding (OLE) is the great integrator on the desktop, letting you paint a picture inside a word processor or listen to a voice annotation in a spreadsheet, ORBs (Object Request Brokers) are fast becoming the great integrators for corporate-wide enterprises.

Most corporations are packed with an assortment of machines and operating systems that run many software products and custom applications. To coordinate such a vast federation of parts, ORBs work across machines, operating systems, and even programming languages. With ORBs, developers can create applications without committing to a programming language, operating system, or network transport. They can also create "wrappers" around older corporate applications and make information available without rewriting existing systems. True network nirvana.

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Tying Together the Corporate Intranet

With an ORB living on the network, multiple servers can communicate with each other. The platform-independent Interface Definition Language (IDL) is the glue that lets clients talk to remote databases and legacy systems



platform software known as CORBA (Common Object Request Broker Architecture), ORBs have been available since 1992. The latest ORBs—based on CORBA 1.2 and 2.0—are now mature products available on over 20 software platforms. And with products now available from Expertsoft, Hewlett-Packard, IBM, Iona Technologies, NeXT, PostModern Computing, Sun Microelectronics, and other developers, corporate America is taking note.

In traditional client/server environments there's a one-to-one relationship between clients and servers. Using ORBs, however, a client can work with multiple servers, servers can work with multiple clients, clients can "discover" new functionality at run

time, and clients and servers need not have direct knowledge of each other. A program that asks an ORB for sales data may get the data from an Oracle database

today and Sybase database tomorrow. The client program never knows which product, operating system, or server is being used.

Anticipating the growth of intranets—internal TCP/IP-enabled networks—and the need to link Web browsers with back-end corporate systems, PostModern Computing recently began alpha-testing software that lets Java applets communicate directly with its ORB. Sun Microelectronics' Neo will provide similar support, while other products like Iona's Orbix and components from I-Kinetics already support OLE-to-CORBA integration. As corporate intranets continue to take off, ORBs are likely to show up on a server near you.—Joshua Kerievsky

Telecom Bill Gets Thumbs Up

Adult Internet content is headed for the Cayman Islands.

After months of heated political debate, the telecommunications bill rocketed through the House on a vote of 414 to 16 and through the Senate on a vote of 91 to 5 and was voted into law by President Clinton. The implications for the Internet—and in particular the penalties against posting "indecent" content—are huge and, in the eyes of many observers, negative.

Civil liberties groups are promising a legal onslaught of opposition. Jerry Burman, director of the Center for Democracy and Technology, has pledged to bring legal action. Jay Friedland of Surf Watch Software is equally prepared to take action.

"I've talked to most of the civil liberties folks out there about this, and you better believe it will face all kinds of challenges," says Friedland.

The Internet-related portion of the law has its roots in Senator James Exon's efforts to regulate Internet service providers and online services. The key parts pertaining to these topics are Section 502e.5 and 502.h3, which cover "Broadcast Obscenity and Violence" and "Obscene or Harassing Use of Telecommunications Facilities." Many early reports have ignored language in the bill that may protect online-service providers and Internet providers. For example, those providers who make "a good faith effort" to allow screening of "indecent" material appear to be protected.

But critics say the bill's language is vague. According to Friedland, the door is still wide open for technological solutions like SurfWatch's Internet-screening software. He doubts the bill will be able to screen much of the adult content available online, simply because the Internet is an international network, and the telecom bill has jurisdiction only in the U.S.

"I just got through talking to an adult-content provider," says Friedland, "who is simply going to move content to servers in the Cayman Islands."—Sebastian Rupley



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By Jake Kirchner

Novell to WordPerfect Users: Drop Dead!

Corel's agreement to acquire Novell's business applications is without a doubt one of the deals of the decade—for Corel, that is. For about \$186 million Corel immediately adds as much as twice that much in annual revenues and inherits an installed base of 20 million PerfectOffice users. When you consider that Corel will pay only about \$10 million of the purchase price in cash, you have to conclude it was like obtaining the Hope Diamond in a \$1 tag sale.

What remains to be seen is whether this deal is anything but a disaster for those 20 million loyal WordPerfect customers.

You will be forgiven if you haven't given much thought to the WordPerfect users amidst the hubbub of the sale. After all, there's no indication Corel or Novell execs have given them much, if any, thought, either. Perhaps they've just been too busy crowing about how they're going to build on this new corporate relationship and turn up the competitive heat on Microsoft, restoring some fire to the office applications market.

Corel president and CEO Michael Cowpland swaggered across the resulting press accounts. He promised to hammer Microsoft by concentrating on Internet-related enhancements to future PerfectOffice versions and by waging a multimillion dollar ad campaign to propel PerfectOffice up the market-share chart.

Am I the only one who thinks it's not braggadocio and massive ad budgets that will pull WordPerfect into the next millennium but strong products with excellent support and regular upgrades? Perhaps I'm just overcome by the strong sense of déjà vu from this turn of events. It was only two years ago that the new tandem of Novell and WordPerfect vowed to make PerfectOffice "a real play-



Strong products and excellent support will make WordPerfect competitive again.

er in the suite and groupware markets," as WordPerfect's then-CEO Ad Rietveld put it at the time.

So much for high hopes and grand schemes.

At that time, Novell paid more than \$1 billion when it acquired WordPerfect and Quattro Pro from Borland International. In that light, this latest deal is much worse than just an embarrassing admission of absolute failure on Novell's part. Novell's two-year-long mismanagement of this line of business was terrible for customers and heartbreaking for employees. Moreover, buying WordPerfect for \$1 billion and dumping it for less than \$200 million is nothing less than irresponsible management of stockholders' assets. The failures that got Apple CEO Michael Spindler run out of Cupertino look like parking tickets in comparison.

Will things be different this time for WordPerfect's increasingly impatient customers? For the sake of the millions of WordPerfect users, I hope Corel can bring to PerfectOffice the same success it has achieved with its other products. But it will take more than \$100 million in advertising to overcome two years of Novell's

incompetent stewardship of one of the PC industry's most valuable franchises.

End users with any kind of significant investment in PerfectOffice applications should be taking a good look at the competing Lotus and Microsoft suites. Given the mishandling of the WordPerfect products over the last two years, they probably are doing so already, but I'd recommend those users make no decision until they see the PerfectOffice 7 versions expected later this Spring.

Corel is going to get only one shot to retain the fabled WordPerfect user loyalty. It had better be a good one.

Skinny Clients to Rule on Web

Corporate intranets will fuel a new breed of applications.

Corporate intranets, networks that use Web browsers to access internal information, are turning out to be more important to companies than the global Internet. At least that's the opinion of Netscape Communications CEO James Barksdale.

At a recent communications and networking conference held in Washington, D.C., he charted the direction in which Internet technology is heading, described a shifting balance of power, and spoke of an imminent sea change in which the Microsoft and Intel standards—known collectively as Wintel—will

give way to a much more open environment based on the TCP/IP standard that connects all kinds of PCs to the Internet.

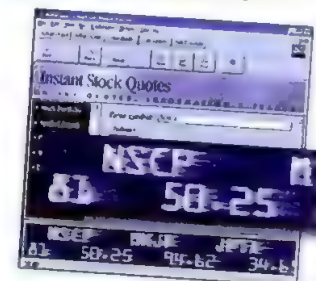
"Not all people on the Internet are trying to sell Maine hunting boots to people with home PCs. The real traffic flow is on the intranet," Barksdale said. And that's where Netscape is making loads of money. About 80 percent of Netscape's revenue comes from supplying the software that companies need to build corporate intranets protected behind firewalls. Already 70 percent of Fortune 1,000 compa-

nies use Netscape software.

The killer apps of the 1980s, the big word processing and spreadsheet programs Barksdale calls "fat clients," will give way to "skinny clients"—small, quick, light, inexpensive applications that rely on communication with live content. HTML and Sun Microsystems' JavaScript provide the "skinny format" that will enable companies to

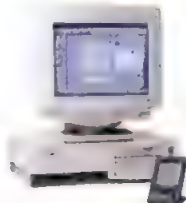
quickly deploy and upgrade corporate applications. "The new balance of power shifts from the vendor to the customer, from Windows and Word to TCP/IP, the Web, and Java," he said.

For Barksdale, former CIO of Federal Express—where the trick wasn't getting a package from New York to California overnight but getting it from Topeka to Minneapolis overnight the challenge now is helping customers take an existing data warehouse, interface it with a skinny client, and bring up a new payroll system over the weekend. The standards are set: HTML for publishing, Secure Electronic Transactions (SET) for security, and JavaScript for applications. "Now everybody can get to work," Barksdale said. —Carol Levin



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First Looks

HANDS-ON REVIEWS OF NEW SHIPPING PRODUCTS

COLOR PRINTERS

HP Color LaserJet 5M: Big, Bold, Beautiful—and a Bargain

By Alfred Poor

Hewlett-Packard Co. has made its next move in the color laser printer market. The innovative HP Color LaserJet 5 family raises the bar for price and performance in this category and is sure to be copied by others. With an estimated street price of \$7,395, the PostScript-ready HP Color LaserJet 5M is one of the lowest-priced network color laser printers yet provides some of the best output quality available. For those who don't need the networking and the 36MB that come included, the Color LaserJet 5, which comes with 20MB of RAM, costs \$5,995.

The Color LaserJet 5 line's 300-dot-per-inch (dpi) specification is at first underwhelming, until you see the near-photorealistic images that the printer is capable of producing. The secret is HP's resolution enhancement technology, REt 1200, which enables the

printers in the Color LaserJet 5 series to create results that come close to 1,200-dpi images.

The key is the Color LaserJet 5 controller's ability to modify the size, placement, and intensity of the toner dots that are applied to the printer's drum. The toner is applied and mixed on the drum's surface, before it is applied to the paper.

COLOR MIX MASTER

It sounds simple, but in fact the two-stage process is very complicated. First the cyan, magenta, yellow, and black toners are

applied to the drum in successive passes. Then the paper passes over the drum and picks up all four toners, which by then have had a chance to blend into their final colors.

The result is that instead of a pointillist representation based on a series of discrete dots of four toner colors in dithered patterns, the printers in the Color LaserJet 5 series produce a more continuous-tone coloring that approaches the results you'd get from thermal dye transfer printers.



COLORIZE THE OFFICE:

The HP Color LaserJet 5M is a behemoth of a printer that can be shared on a network.

The closer you look, the better the output appears. Blended colors such as reds and greens are smooth, rich, and saturated, and edges are sharp.

A big step forward is the surface quality of the prints. Instead

Continues on page 40

INTEGRATED SOFTWARE

ClarisWorks Delivers Tight Application Integration Without Razzle-Dazzle

By Edward Mendelson

ClarisWorks 4.0, the \$49 integrated Windows 95 application package from Claris Corp., packs most of the features small businesses need into a mere 12MB of disk space. Although it lacks the automated razzle-dazzle of Microsoft Works, it has a generally more useful feature set and a less intrusive interface.

ClarisWorks doesn't try to integrate deeply with Windows 95 and lacks extensive keyboard shortcuts, but you'll be impressed by how much you can achieve within the program itself. The basic modules include a word processor, a spreadsheet, a database, and powerful drawing and painting tools.

LABELS ARE US: ClarisWorks' Label wizard creates mailing labels from database fields.

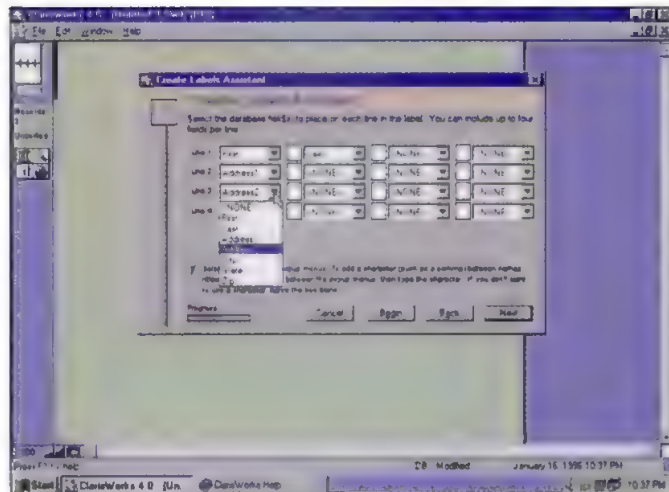
Among features normally found only in standalone packages are recordable keyboard and mouse macros, a feature that converts documents into slide shows, professionally coordinat-

ed color palettes, and floating toolbars that can be customized for individual documents. ClarisWorks also lets you import and export HTML files, in addition to

Continues on page 43

IN FIRST LOOKS

Painter 4.....	44
One-Write Plus	
Version 5.0 for Windows.....	45
LapLink for Windows 95.....	48
Norton pcAnywhere 32	
for Windows.....	48
Neural Connection 1.0.....	51
PC411 for Windows 1.1.....	51
Intel 150-MHz Pentium	
OverDrive Processor.....	54
PartitionMagic.....	56
SuperPrint 4.0.....	56
HP ScanJet 4p.....	60
Labtec Imager.....	63
Incredible Sound.....	63
Vivid 3D Proex.....	63
ACI-1016 SCSI Booster.....	66
Compadre.....	66
NEC MultiSync LCD200.....	69
Citizen Printiva 600C.....	69



First Looks

HP Color LaserJet 5

Continued from page 39

of the oily sheen found on the output of most color laser printers, the prints produced by the units in the Color LaserJet 5 series have a smooth matte finish.

The toner layer of these prints is no thicker than that of monochrome laser toner. If you want glossy output, you can use the special coated stock designed for this printer family. These printers can make overhead transparencies but can't use self-adhesive labels.

Despite the fact that the Color LaserJet 5 printers produced stunning output over a range of samples, we observed two shortcomings. First, if you print a large continuous-tone image that has light areas, such as a daytime outdoor scene, there may be vertical pinstriping; smaller, darker images print without this problem. Second, the Color LaserJet 5 family of printers can't print to the edge of the paper; like most printers, the units produce a region about one-eighth of an inch wide around the sheet's perimeter in which nothing is printed.

QUICK ON THE DRAW

The Color LaserJet 5 printers not only make good-looking prints; they are also fast. Once the data had been transferred to the printer and formatted in the page buffer, our Color LaserJet 5M evaluation unit was able to churn out additional copies of a full-color page at about 2 pages per minute (ppm).

Members of the Color LaserJet 5 family need to do more than make pretty pictures, because the bulk of office printing involves black text on plain paper. The built-in resolution enhancement does an excellent job of smoothing the edges of characters. The print engine, rated at 10 ppm, was able to push out pages on our Print Speed test at 8.5 ppm in both PCL and PostScript modes. Units in the Color LaserJet 5 line can print monochrome images and text on 11- by 17-inch paper, but color prints are limited to 8.2 by 10.7 inches on 8.5- by 11-inch paper.

In a departure from its all-in-one cartridge approach for monochrome lasers, HP has designed the Color LaserJet 5 series with separate consumable components. The result is that the most expensive components, such as drum and developer units, last longer and reduce the printers' cost per page to the realm of monochrome laser printers.

According to HP's calculations, which include all

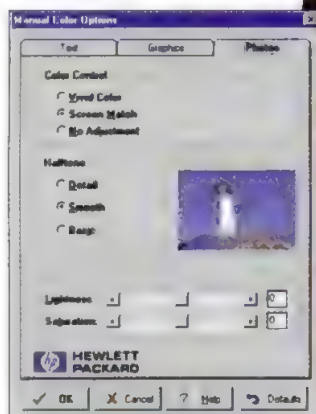
on a LaserJet 4 Plus. A typical report page with a mix of text and color and 15 percent color coverage costs about 5 cents per page when printed with a Color LaserJet 5 unit.

At these prices, you might be tempted to use the Color LaserJet 5 to print everything, and the 30,000-page-per-month duty

lem with these printers is their size. At roughly 2.0 by 1.5 by 1.3 feet and just over 100 pounds, they are behemoths, and you shouldn't consider moving them on your own.

WINDOWS 95-READY

The Color LaserJet 5 series comes with drivers for Windows 3.x and Windows 95. In addition,



LOW RES, HIGH QUALITY: The 300-dpi HP Color LaserJet 5M trades resolution for stunning image quality. The manual adjustments produce astounding results.

consumables except paper, a standard black-and-white text page at 5 percent coverage costs 1.8 cents, about a third less than the cost for most desktop mono-



FONT CENTRAL: The HP Color LaserJet 5M comes with a handy font management utility for Windows that can help with installing, removing, and sorting out fonts.

chrome laser printers. By the same token, a page with 50 percent color coverage (such as a large photographic image) costs about 20 cents to print, slightly less than the 21.5 cents HP estimates it would cost to print the same image in black and white

cycle will likely suffice for most offices. Sharing the printer is easy. The basic model comes with a bidirectional high-speed parallel port, but it also has an MIO slot that accepts HP's Jet-Direct network connection cards. The Color LaserJet 5M that we tested adds an Ethernet/LocalTalk interface along with PostScript; the unit also has automatic emulation switching, making it easy to set up configurations suitable for shared use.

The basic Color LaserJet 5 is a little weak when it comes to paper handling, with only a single 250-sheet paper tray, a 100-sheet output tray, and no manual-feed slot. An optional rear paper tray adds a second 250-sheet tray and a manual-feed slot, which increases the paper capacity a bit.

The only other possible prob-

tion, you'll get HP's ColorSmart technology, which can automatically identify text, spot-color, and continuous-tone color elements on a page and adjust the print settings to make the most of each region. You can also specify your own settings if you prefer. The Color LaserJet 5 line also comes with a handy font management program.

If you've been waiting for a color laser printer that is fast enough and has a sufficiently low cost per page so that you can use it for all your printing needs, the members of the Color LaserJet 5 family should fill the bill. For the price of a few monochrome desktop printers, you can have one that can be shared among a number of users for a variety of printing needs, including beautiful color.

HP Color LaserJet 5M. Estimated street price: \$7,395. Requires: PC with parallel port or network. Hewlett-Packard Co., Direct Marketing Organization, Santa Clara, CA; 800-527-3783; <http://www.hp.com/>. Circle 435 on reader service card.

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ClarisWorks 4.0

Continued from page 39

most PC and Macintosh formats.

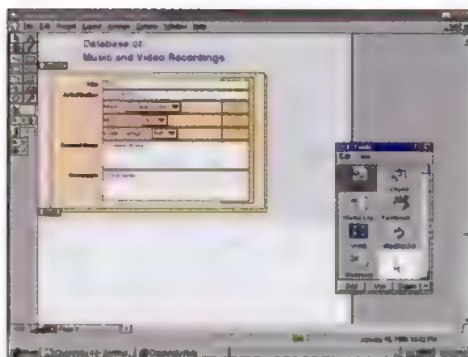
When you open ClarisWorks, you have a choice of opening a blank document or using one of 11 Assistants—Claris's answer to Microsoft's Wizards—to build a document. There are Assistants to create calendars, presentations, agendas, HTML files, and other common document types. Other Assistants walk you through basic financial planning or building an address database.

The word processing module is versatile and flexible, supporting multiple columns and single columns in a single document—a useful feature not found in Microsoft Works. You can also incorporate footnotes or endnotes, typographic (curved) quotation marks, and automatic hyphenation. Hyperlinks in HTML files are stored as footnotes, and although only HTML 1.0 features are directly supported, you can manually insert the codes for creating more advanced features; unsupported codes remain intact during import and export.

A useful option lets you turn off the display of margins. This way, only a minimal amount of screen space separates the last line of one page from the first line of the next.

ClarisWorks' outliner automatically renumbers paragraphs when you move them with the mouse and includes basic hide and display options. The spell-checker lets you select a replacement word by typing a number on a list without making you use the Arrow keys or the mouse. The speller window obscures the text being checked, and an option to display a few words around the questionable word doesn't fully compensate for this.

Graphics can be anchored in documents as if they were words so they move with the text flow, or as framed objects that can be



OLE, YEA OR MAY: An optional icon palette displays OLE server applications from which you can insert objects in ClarisWorks files.

moved anywhere. You can also wrap text around them.

The drawing and painting tools are intuitive and responsive, and objects can be resized and reshaped either with the mouse or by entering precise measurements in a dialog box. Objects can also be rotated in one-degree increments and connected intelligently so that one object snaps either to the starting point or endpoint of another object.

The drawing module doubles as a basic presentation package and supports master pages, which act as background templates. Painting tools include the standard brush, pencil, and spray can, as well as a magic wand that selects adjacent pixels of the same color or multiple colors. Special effects such as rotation and perspective can be applied to text within frames as easily as they can be applied to images.

ClarisWorks' spreadsheet module supports more than 100 functions, including auto-fill of names of months but not auto-sum features. If you design your own spreadsheets, you'll want a standalone program, but if the built-in financial planning Assistants are sufficient, the spreadsheet module will provide colorful output and a variety of charting options.

There are a large variety of field types in the database module, including radio buttons,

check boxes, and switches between a spreadsheet view of your data and a layout view. Mail-merge in the word processing module is tightly integrated with the database.

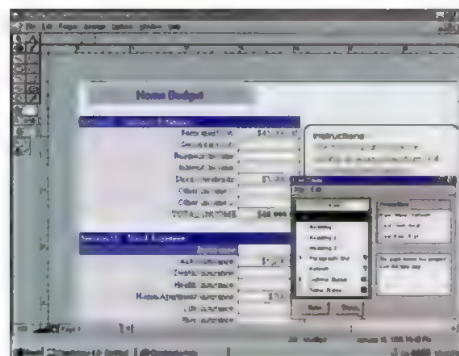
ClarisWorks' communications option merely opens Windows 95's built-in applet, HyperTerminal. Unfortunately, there's been no effort made to integrate it with the rest of the program, as is also the case with the included SofNet FaxWorks.

The interface features Claris's standard design and should be familiar to users of the graphics package ClarisImpact and the database FileMaker Pro. A toolbar lets you use virtually all the tools from any module in any

The style toolbox in ClarisWorks lets you modify styles by using the same top-line format menu used for editing text. This logical design belongs in high-end standalone applications. Library roll-ups can store text, images, spreadsheet cells, and clip art; libraries supplied with the package include clip-art images, and you can import other images.

A special toolbar within ClarisWorks supports OLE by displaying the icons of applications that can embed objects in ClarisWorks documents. You can't edit in place within ClarisWorks documents, however. ClarisWorks is an OLE client only, so you can't drag text or graphics from it to other applications, and you can't even drag and drop between one ClarisWorks window and another. But you can cut and paste using the right-click pop-up menu.

The main flaw in the interface is the limited keyboard-shortcut support. For example, to change the zoom level, you have to click on either an icon or a field on a status bar. You have to use the mouse to start the process of creating or modifying a style. The dialog box used for customizing the Shortcut toolbars includes underlined letters that signify shortcuts, but some don't work.



BUDGETS: Predesigned spreadsheet layouts guide you through basic financial planning.

other module: A spreadsheet tool inserts a table in a text file or graphic image, and drawing and painting tools let you illustrate a spreadsheet, database layout, or word processing file.

A floating roll-up Shortcut bar displays tools for commonly used features. Different sets of tools appear automatically when you work in text, graphics, or spreadsheet modes, and you can customize the tools that appear in every window and the set that appears in any individual document. If you don't like puzzling out the meaning of an icon, the Shortcuts can be displayed by name.

If you don't mind heavy reliance on the mouse, ClarisWorks gets many jobs done efficiently and flexibly. Despite its interface shortcomings, ClarisWorks 4.0 is easier to live with than the in-your-face style of Microsoft Works, and its strong feature set and economical use of disk space make it an attractive choice for home or small-business use.

ClarisWorks 4.0. List price: \$49. Requires: 8MB RAM, 12MB hard disk space, Microsoft Windows 95. Claris Corp., Santa Clara, CA; 800-544-8554, 408-727-8227; <http://www.claris.com>. Circle 412 on reader service card.

FIRST LOOKS PLUS

From March 11 to 15, go online to discuss ClarisWorks 4.0 with Claris Corp.'s John Perr and Edward Mendelson, a contributing editor of PC Magazine. Type GO EDITORIAL on CompuServe.

ILLUSTRATION

Painter 4 Adds Mighty Features And Great Artistic Tools

By Luisa Simone

Fractal Design Corp.'s Painter is well known as a raster graphics program that uses fractal algorithms to simulate the artistic and often serendipitous effects of traditional art media—such as charcoals, watercolors, and oil paints. The \$549 Version 4 holds true to that tradition with an entirely new painting mode that mimics the construction of a mosaic. A new module, Net

to create novel text effects.

Painter 4 provides special functions for artists who are working on the World Wide Web. For example, you can assign URLs to any floater in a picture. When exported to .GIF or JPEG files, the floaters are converted to clickable hot spots. Painter's .GIF export also supports interlacing for faster displays and transparency.

You can also use Painter's Net Painter feature to create collaborative artwork on the Internet or a TCP/IP network. Net Painter delivers great performance by relying on the program's robust scripting commands. Instead of sending pixels over the network, Painter transmits instructions, which are then executed locally on all of the connected computers.

Support functions for Net Painter include traffic-control lights (you can only paint when your light is green) and a chat window. There are some inherent limitations: For the commands to be executed properly, all of the users must be working with the same Painter resources, such as paper textures, nozzle images, and shape preferences.

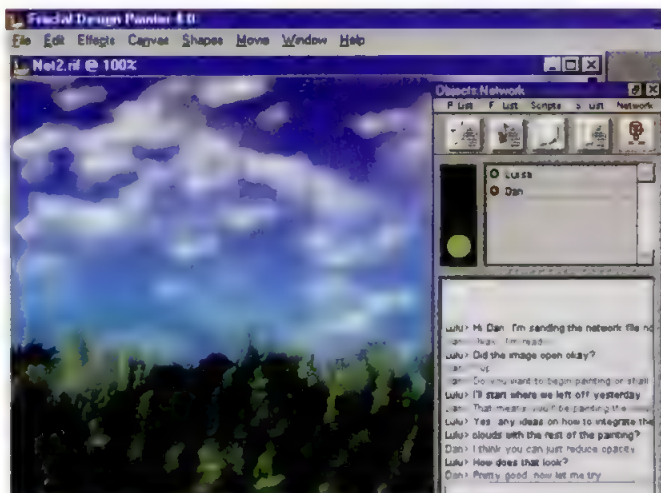
Several of Painter's functions that don't respond to scripting can't be used with Net Painter. For example, animation is out of the question; frame stacks will cause Net Painter to crash.

There are, of course, a host of other new features that add to the program's usefulness. The program's emphasis on objects (whether raster or vector) is reflected in several new layout tools that help you arrange compositions more precisely. Movable guidelines can be pulled out from rulers. And an alignment dialog box lets you position selected ob-

jects in relation to one another. One of the biggest benefits of Painter 4 is its ability to interleave raster objects (called floaters) and vector shapes on an illustration. These shapes offer the advantages commonly associated with vector objects: precision drawing (thanks to Bezier curve, rectangle, and ellipse tools) and editing controls (node- and tangent-control points). Painter adds its own twist by allowing you to assign compositing attributes (such as transparency, gel, or colorize) to a shape—a nice implementation of combined vector and raster objects.

These vector tools are not meant to compete with dedicated drawing programs. The deliberately limited toolset is suited to simple outlines, not to sophisticated renderings. Indeed, the only way to make shapes more visually interesting is to convert them into raster floaters and employ Painter's brushes and image-editing filters. In addition, we experienced noticeably slow performance when working with vector shapes, especially when node editing. The most useful aspect of this technology is that type is preserved in vector format—making it easier

FIRST LOOKS
From March 18 to 22, go online to discuss Painter 4 with Fractal Corp. executives Steve Guttman and John Derry and Luisa Simone, a contributing editor of PC Magazine. Type GO EXEC at any CompuServe! prompt.



CYBER CREATIONS: Net Painter lets you take turns painting on the same digital canvas with other users on a TCP/IP network. A traffic light controls access and a chat window lets users coordinate their efforts.

jects in relation to one another.

Painter's reorganized interface makes commands that are used less frequently much easier to find by moving them from the main menu to submenus located on individual palettes. For example, the menu commands for brushes are now located on the Brushes palette. Fractal Design has bundled several bonuses on Painter's CD-ROM, including additional paper textures and clip-art images and an entire CD that has image nozzles of flowers and leaves.

Other new features seesaw between good news and bad news. The new Color Correction tool lets you use gamma curves to modify an image's color balance. But without the support of a color management system, there is no guarantee that the screen will match printed output. And while the CD-ROM ships with both native Windows 95 and Windows 3.1 versions of the program, there is confusion concerning how each version supports third-party products.

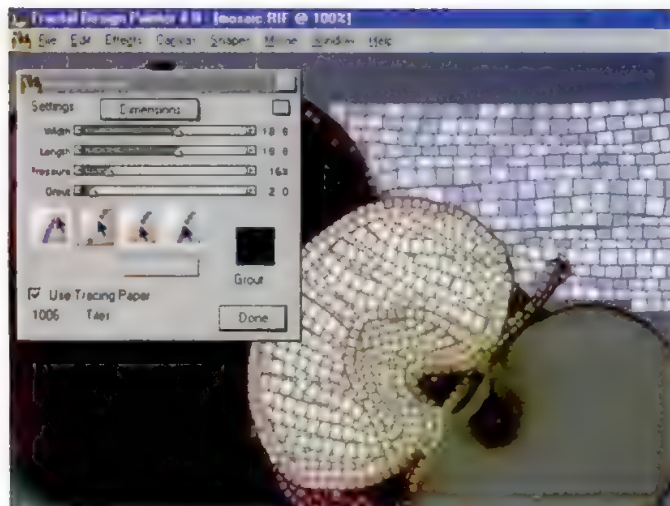
Painter Makes Mosaic Magic

With brushes that can reproduce everything from grainy pencil marks to bristly oil paints and wet watercolors, Fractal Design Corp.'s Painter 4 can simulate any imaginable forms of natural media—including some new ones that will excite electronic artists.

Painter 4 tackles the ancient art of mosaic tiles with startlingly realistic results. Two related functions—Make Mosaic, which uses regularly shaped tiles, and Make Tessellation, which uses randomly shaped tiles—exhibit what at first seems like an oddball mixture of raster and vector technology.

To generate a tessellation (in which irregularly shaped polygons are pieced together to form a picture), you first enter vector information, such as the number of data points and the general shape of the polygons (triangles, for example) that will be used for the mosaic mesh. Likewise, generating the roughly rectangular mosaics requires you to set up parameters that control the size, shape, and variability of the tiles.

Painter creates and maintains each tile as a separate object, as though the mosaic were a vector image. This enables the program to respect the boundaries of existing tiles when it cuts new tiles



TILE IT: Click on Make Mosaic to try a completely new painting mode within Painter 4. You can change the shape, size, texture, and color of the tiles with the dialog box.

On our tests, the Windows 95 version installed only 32-bit .DLLs and therefore would not work with 16-bit plug-ins. You can manually substitute 16-bit .DLLs, but then the program will no longer work with 32-bit plug-ins. In addition, we found that the Windows 95 version does not support 16-bit Twain drivers. Twain support is only available when using the Windows 3.1 version.

Painter 4 functions as a bridge that links traditional art media (albeit as simulations) to the next

wave of electronic graphics. With an upgrade price of only \$129, this is one painting program that no graphics professional can afford to be without.

Painter 4. List price: \$549; upgrade, \$129. Requires: 8MB RAM, 20MB hard disk space, Microsoft Windows 3.1 or Windows 95, pressure-sensitive digitizing tablet recommended. Fractal Design Corp., Aptos, CA; 800-297-2665, 408-688-5300; fax, 408-688-8836. *Circle 411 on reader service card.*

and grouts them. You never have to worry about butting tiles against one another; just pass the brush over an area and Painter figures out the complicated geometry and paints the results. At any point, you can remove, recolor, and even rerender tiles if you're not happy with the results.

Ultimately, however, Painter renders the tiles as a raster picture. For example, you can use the tile data to generate a mask and then use standard raster special-effects filters (such as Apply Surface Texture) to create a three-dimensional effect, complete with shadows and highlights.

During testing, we found that the command that supposedly fills a selection area with tiles only works for circles. Elliptical, free-form, and rectangular selection areas were only partially filled. The program also failed to remember the correct grout color between work sessions, a small inconvenience that required us to rerender the tiles.

Compared with the artistic possibilities and just plain fun that making a mosaic provides, these are very minor problems. Whether you are painting from scratch or cloning an existing image, Painter's Mosaic and Tessellation functions point toward a new painting paradigm that integrates the power of vector attributes with the photorealistic look of raster pictures.—LS

ACCOUNTING

One-Write Plus Provides Basic Bookkeeping at a Low Price

By Kathy Yakal

It's been a long time coming, but the first Windows version of the small-business accounting program One-Write Plus is finally here. One-Write Plus Version 5.0 for Windows retains the simplicity of its DOS predecessor, and with an estimated street price of \$69.95, it costs less than its competitors.

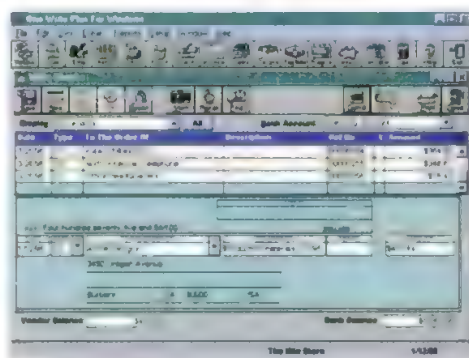
The extensive tutorial included with One-Write Plus walks you through the process of building your company's books and explains other program operations. It takes your answers to its questionnaire and creates a customized printout of setup procedures. Because the tutorial is a separate item in the program group, you first have to minimize One-Write Plus, then launch the tutorial and print any information you want to refer to while working in the main program.

Alternatively, you can just dive in and set up your books without experiencing much trouble, using the program's setup checklist and Setup menu. One-Write Plus asks you for information such as your fiscal-year dates and your preferred Chart of Accounts. The program includes templates for 14 business types, including legal and service-based businesses, as well as generic custom and nonprofit templates; there's also a template for a personal-finance program.

Though the level of detail displayed in the transaction screens isn't as in-depth as that found in some competitors, One-Write Plus can streamline small businesses. You can write checks; send bills and invoices; set up budgets; track Accounts Payable,

Accounts Receivable, and Payroll; maintain a General Ledger; and reconcile bank accounts. Many of its forms, like the three types of invoices, resemble their real-life counterparts; others, such as checks, don't. But these forms and their corresponding registers appear on-screen simultaneously, which is a nice feature.

One-Write Plus offers 69 different boilerplate reports that can be modified by parameters such as accounts and customer ID numbers, but formatting options are limited. Bigger businesses may need more reporting horsepower, as well as network support, a full-blown inventory module, multilevel passwording, and job-costing capabilities.



FILL IN THE BLANKS: One-Write Plus lets you display forms simultaneously, such as the ones in the Write Checks window.

Although it can't compete with market leaders such as Peachtree and QuickBooks in areas such as transaction processing and integrated setup help, One-Write Plus Version 5.0 for Windows covers the essentials required by many small businesses at a hard-to-beat price.

One-Write Plus Version 5.0 for Windows. Estimated street price: \$69.95; upgrade, \$49.95. Requires: 8MB RAM, 21MB hard disk space, Microsoft Windows 3.1 or later. NEBS Software, Nashua, NH; 800-882-5254, 603-880-5100. *Circle 410 on reader service card.*

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REMOTE-CONTROL SOFTWARE

Two New Routes to 32-Bit Remote Control

By Ben Z. Gottesman

Symantec Corp. and Traveling Software have brought their popular remote-control programs in sync with the 32-bit world. Both Symantec's Norton pcAnywhere 32 for Windows and Traveling Software's LapLink for Windows 95 sell for \$149 and are designed to take full advantage of the Windows 95 environment. But the programs differ in terms of performance and features.

Traveling Software includes the 16-bit version of LapLink; pcAnywhere is backward-compatible. pcAnywhere also works on systems running Windows NT. Longtime pcAnywhere users will notice several new setup wizards and extensive support for property sheets. In LapLink, the changes

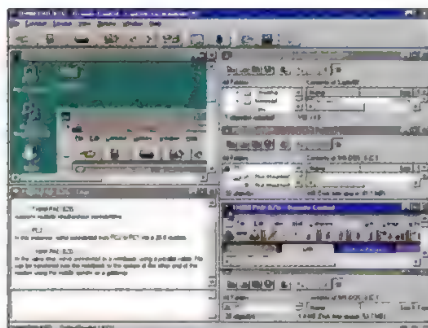
for more networking protocols (LapLink only supports IPX and TCP/IP), pcAnywhere also includes a terminal program and a scripting language, as well as the ability for one system to act as a modem gateway.

Still, most users of LapLink will not find it lacking in features, although we were disappointed that the program still doesn't support remote printing natively. Both programs integrate well with Windows 95's Dial-Up Networking, permitting users remote node and remote control in the same session. We liked LapLink's all-at-once approach, which allows a system to be a remote and host simultaneously, even over multiple connection types. By contrast, pcAnywhere supports one such connection at a time, and you must designate the host and the remote PC.

The two programs take very different approaches to transferring screens from the host system to the remote system. LapLink sends .GDI commands and builds every screen on the remote system as it appears on the host. In contrast, pcAnywhere transfers

bitmaps of the screen and will not transfer portions that were overwritten on the host before they were sent to the remote system.

With LapLink's approach, the user of the host system may experience somewhat sluggish response.



SIMULTANEOUS SESSIONS: With LapLink, your system can be a remote and host at once.

The user of the host system with pcAnywhere will notice very little drag, but the remote user may not see everything that is happening on the host. Across a modem, pcAnywhere's approach worked better for sending large graphics or for viewing pages in a World Wide Web browser. LapLink was much quicker at drawing dialog boxes and menus, however.

We measured each program's performance for file transfer and remote control on a pair of 66-MHz 486DX2 test-beds. To test file transfer, we sent a 2.8MB database from one system to the other using V.34 modems at 28.8-Kbps throughput. pcAnywhere completed the task in about 23 percent less time than LapLink.

Raw throughput doesn't tell the whole story, however, because both programs have the ability to send file updates. LapLink's SpeedSync sent the changes to our test database in less than half the time that pcAnywhere's SpeedSend took. The latter program has

the ability to check for viruses during transfers, which probably slowed our test transfer.

We also tested remote control over an IPX network and found

that LapLink was unstable when using our Proteon 1392+ Token-Ring adapters, until we stepped down from the 32-bit protected-mode drivers to the 16-bit NDIS drivers. Once we had the program working properly, LapLink consistently outperformed pcAnywhere on our network. With LapLink, we felt as though the remote sys-

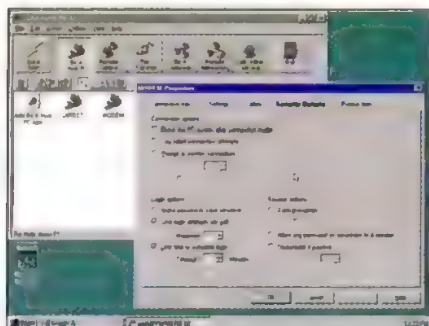
tem was performing tasks locally, but when we switched to pcAnywhere we still felt as though we were using a modem. The pcAnywhere remote system also could not keep up with rapid typing on the host system. Symantec plans to fix this problem shortly.

Both programs have taken several steps to improve remote performance. LapLink automatically shows the host in 16 colors; pcAnywhere can view the host in its native color depth or use the new ColorScale feature to depict the host in 2, 4, or 16 colors. Both programs can also disable backgrounds and screen savers.

pcAnywhere provides support for more network protocols and operating systems, but most organizations will find LapLink's more flexible client and intuitive screen transmission a better solution.

Norton pcAnywhere 32 for Windows. Estimated street price: \$149. Requires: 4MB RAM, 16MB hard disk space, Microsoft Windows 3.1, Windows 95, Windows NT, or DOS 6.22. Symantec Corp., Cupertino, CA; 800-441-7234, 408-253-9600; <http://www.symantec.com>. Circle 436 on reader service card.

LapLink for Windows 95. Estimated street price: \$149. Requires: 8MB RAM, 7MB hard disk space, Microsoft Windows 3.1 or Windows 95. Traveling Software, Bothell, WA; 800-343-8080, 206-483-8088; <http://www.travsoft.com>. Circle 437 on reader service card.



FULL-FEATURED: pcAnywhere has more security options and supports more protocols.

are more subtle and evolutionary. Both include a parallel cable for file transfers, but LapLink also provides a serial cable.

pcAnywhere is the deeper program of the two. In addition to more security options and support

PERFORMANCE TESTS



32-Bit Remote-Control Programs

On our File Transfer test, Norton pcAnywhere 32 for Windows transmitted a 2.8MB database in about 23 percent less time than LapLink for Windows 95.

On our File Update test, LapLink transmitted our changes to the database file in less than half the time that pcAnywhere took.

To gauge the performance of the remote-control programs, we used a pair of 486DX2/66 systems equipped with V.34 modems capable of 28.8-Kbps throughput. Both systems



were running Windows 95. For more details on our performance test results, see our Web site at <http://www.zd.com/>.

A woman in a white, ruffled dress and a tiara is smiling and holding a long, thin object, possibly a wand or a microphone, on a stage. The background is dark with red curtains and a large, ornate chandelier. The text "You Know It's A Great Performance..." is overlaid on the right side of the image.

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And if it belts out power performance and sound like no other, then it's gotta be a Gateway 2000® computer! Gateway's high-end P5-166XL professional multimedia system gives you extraordinary performance, even for your most robust computing needs. Top it off with the Gateway-exclusive Altec™ Lansing ACS-400 speakers, and the P5-166XL ushers you into first-rate stereo sound! And our new P5-150 Professional system delivers the performance your heavy-duty business applications require — for just \$2,899! The Intel® 166MHz and 150MHz Pentium® processors, included on these systems, are the fastest Pentium processors available today. These systems also include the new ATX motherboard, giving you enhanced functionality, usability and reliability.

An Encore 166MHz Performance

Bravo! Gateway's P5-166XL is "*the fastest Windows 95 PC ever,*" per *Windows Sources*, February 1996. You'll leap to your feet when you experience all the powered-up features of the P5-166XL. This impressive system is built with 16MB EDO performance DRAM, 512K pipelined burst cache and 2GB hard drive for unbeatable performance.

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Spine-tingling, heart-thumping stereo sound resonates from your Altec Lansing ACS-400 speakers, standard on the P5-166XL and exclusively from Gateway 2000. Including the Altec ACS-250 subwoofer, these speakers give you thunderous bass and extraordinary Dolby® Surround Sound, breathing new life into all your multimedia applications and music CDs! And you'll be amazed by the ultra-realistic sound achieved with the included Ensoniq® Wavetable sound card. Add these performance features to a Matrox® 2MB WRAM graphics accelerator with MPEG video scaler and your 3-D graphics and multimedia applications will run with incredibly smooth video playback.

The Speedy 6X CD-ROM Drive!

Now standard on all Gateway Professional systems is the 6X CD-ROM drive. This super-fast CD-ROM drive accelerates all your computing experiences to the next level of CD-ROM technology and performance so your applications run ultra fast, *and* you'll be more than ready for tomorrow's complex software applications.

The Right System For All Your Hit Applications

All Gateway Pentium processor-based PCs include Microsoft® Windows® 95, and our Professional models also include MS Office 95, Professional Edition, compatible with 32-bit applications and with backward compatibility for 16-bit applications. If you prefer a different operating system, Gateway gives you a choice of MS-DOS® and Windows for Workgroups, Windows NT™, or Windows 95, and we'll preload your operating system so your PC is ready to run!

Software Diva

The grand finale: The P5-166XL has one of the *best* software bundles found *anywhere* with MS Office 95, Professional Edition and Gateway's Generations II Software Collection for use with the Windows 95 operating system. It's just what you need for business applications in the Windows 95 environment, *and* for the most complete, updated versions of the latest and greatest multimedia applications, most optimized for Windows 95. A gaming pad is included for use with all your entertainment software.

And Introducing Gateway's P5-150 Professional PC!

For extraordinary levels of performance, Gateway introduces our P5-150 Professional system! It includes the ultra-fast 150MHz Pentium processor, 16MB EDO performance DRAM and 256K pipelined burst cache. All Gateway Professional Pentium processor-based systems have 16MB EDO performance DRAM, and most are standard with pipelined burst cache, adding up to the ultimate in system performance. These features also give you a faster, more cost-effective means to great performance. The P5-150 comes in a new "mini" tower case with similar expansion space found in a desktop case. Because the mini tower case is so compact, you can put it just about anywhere. Call Gateway 2000 today and find out about all our legendary performance machines!

If You're In Awe Of Your High-Flying **Multitasking** Machine...

The Gateway 2000® G6-200: A Legendary Performance

And if you just can't function without jet-set workstation power and performance — we're talking the top-flight machinery available today — then a new Gateway 2000 G6-200 is definitely for you! This new generation of workstations combines a 150MHz or 200MHz Intel® Pentium® Pro processor with Windows NT™ Workstation operating system and a configuration that'll send you soaring into the wild blue computing yonder!

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The Pentium Pro processor is Intel's latest generation processor designed to provide workstation users with ultra-high performance in true 32-bit environments. The Gateway G6-200 is classified as a value workstation, perfect for CAD applications, intense desktop publishing, and graphics and design applications. If you require a load of memory and storage space to run your heavy-duty network applications, you won't find a better value from any other workstation manufacturer.

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To achieve the high throughput and superior performance your intense applications require, we've included a 2GB Fast SCSI-2 hard drive on the Gateway G6-200. SCSI technology offers better performance in workstation environments. And the SCSI interface allows you to connect up to seven internal SCSI devices, so you can expand like never before. The G6-200 also includes an Adaptec® 2940 32-bit PCI Ultra SCSI Fast-20 controller. Combine all this with 64MB DRAM and your workstation applications will fly!

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With the Matrox® 4MB WRAM video card standard on our G6-200, you'll get incredible graphics support at higher resolutions, along with hardware accelerated 3-D support and increased color depth.

Workstation Wonderland with Windows NT Workstation

All right, Windows NT Workstation customers, you know who you are. And we want to get to know you! Gateway 2000 now proudly offers you the best value on the Windows NT Workstation 3.51 operating system in the industry, and standard on Gateway's G6 models. This is one of the most powerful operating systems for any organization that depends on a computer for today's most demanding data-intensive business applications. And if you value the reliability and security of privacy in large workstation environments, Windows NT Workstation is perfect for you.

Great news Windows NT 3.51 users! Your Gateway 2000 G6 system will arrive preloaded with Windows NT Workstation ready to run! Simply determine and enter your individual security codes and passwords during initial setup. We'll configure all G6 systems with the appropriate Windows NT 3.51 drivers, loaded and optimized for compatibility with Gateway hardware and software.

Along with Windows NT, you get MS Office 95, Professional Edition for the best 32-bit business software applications available. And you can upgrade Pentium processor-based and Pentium Pro processor-based PCs to Windows NT for a value that can't be beat!

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If You've Found The Ultimate Communications Device...

And if your family has a penchant for the latest (*and coolest*) in multimedia, then it's just got to be a Gateway! All Gateway 2000® Family PC™ multimedia systems provide everything your family needs for education, entertainment and for your home office. And our TelePath® fax/modem with a Telephone Answering Device lets you reach out to neighbors next door or across the globe!

Out Of This World Performance and Features For Your Family!

Along with great multimedia features, the Gateway P5-120 Family PC system includes 16MB EDO performance DRAM and a 1.2GB EIDE hard drive. A 6X CD-ROM drive, standard on all Family PC systems, gives your family the power and performance to get down to serious business or to play thrilling multimedia games.

Holy amplifiers PC buyers! It's Gateway 2000's super stereo sound system: our exclusive Altec™ Lansing ACS-40 speakers and 16-bit Gateway sound card on Family PC systems. Your multimedia applications will blast off with realistic sound, and music CDs will be like *super* music to your ears!

Get Hooked Into MPEG Technology

We wouldn't lead you up an outdated technology tree. No way! Now all Gateway 2000 Family PC multimedia systems include MPEG (Moving Picture Experts Group) data compression technology. MPEG provides superior stereo sound, along with incomparable full-screen, full-motion video right from your CD-ROM drive. Video from MPEG multimedia applications will be smoother. And your multimedia images come to life when combined with the MPEG video scaler, standard on Family PC systems.

Reaching Out To New Worlds With The Gateway 2000 TelePath 28.8

Your communication needs are satisfied with the TelePath 28.8 fax/modem standard on most Gateway Family PC systems! The TelePath fax/modem state-of-the-art with the ability to fax, transfer files and access online services. But there's more! It's also a complete communications tool with a Telephone Answering Device (TAD) for answering machine capabilities. It also includes Gateway's exclusive Information Highway communications CD, with a user-friendly interface and easy-to-use tutorial of included trial memberships to CompuServe®, Prodigy®, America Online® and





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- 2MB DRAM, 64-Bit PCI Graphics Accelerator with MPEG Video Scaler
- 6X EIDE CD-ROM Drive
- 16-Bit Gateway Sound Card
- Altec™ Lansing ACS-40 Speakers
- TelePath® 28.8 Fax/Modem with TAD*
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- CrystalScan®15 .28dp Color Monitor (13.9" viewable)
- 7-Bay Desktop Case
- 104* Keyboard & MS Mouse 2.0
- Microsoft® Windows® 95
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P5-100 \$2099

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(75MHz Pentium processor, 1MB DRAM, 850MB HD, TelePath 14.4 fax/modem, CrystalScan14 w/ 13.4" viewable screen)

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- Altec Lansing ACS-40 Speakers
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- TelePath 28.8 Fax/Modem with TAD*
- Gateway Information Highway CD
- 3.5" Diskette Drive
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- 7-Bay Desktop Case
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- Intel 133MHz Pentium Processor
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G6-150

- Intel 150MHz Pentium Pro Processor
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- 256K Internal Cache
- 2GB 10ms EIDE hard drive
- Matrox 2MB WRAM Graphics Accelerator w/ Video Scaler
- 6X EIDE CD-ROM Drive
- 3.5" Diskette Drive
- Vivitron17 .26dp Color Monitor (15.9" viewable)
- 12-Bay Tower Case
- 104* Keyboard & MS Mouse 2.0
- MS Windows NT Workstation 3.51
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G6-200

- Intel 200MHz Pentium Pro Processor
- 64MB DRAM
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- 2GB Fast SCSI-2 9ms Hard Drive
- Adaptec® 2940 32-bit PCI Ultra SCSI Fast-20 Controller
- Matrox 4MB WRAM Graphics Accelerator w/ Video Scaler
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** MS Office 95, Professional Edition includes Word, Excel, PowerPoint® presentation graphics program, Schedule+, Access database and Bookshelf® 95.

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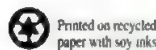
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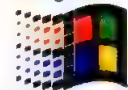
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Choose a Gateway 16-bit CD-quality sound card or an Ensoniq[®] Soundscape[™] 16-bit wavetable sound card. Both are Sound Blaster[™] compatible and include two Altec[™] Lansing ACS-40 speakers.

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The Dolby[®] Surround Sound Gateway-exclusive ACS-400 speaker system will make your multimedia applications come alive with true theater-like surround sound. Complete with two Altec ACS-400 satellites and ACS-250 subwoofer.

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Internal fax/modem, 28,800bps modem, V.34, with 28,800bps fax capability. Sends and receives data and faxes, and includes Telephone Answering Device (TAD) for full voice mail capabilities. Includes trial memberships to CompuServe[®], AOL and Prodigy[®] and more! **\$149** (TelePath 14.4 Fax/Modem \$79)

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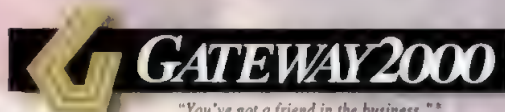
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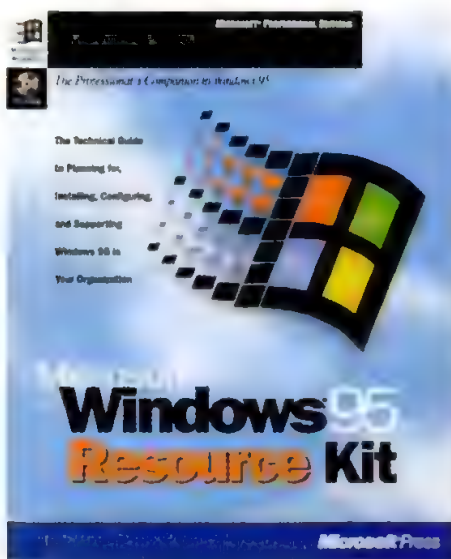


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Windows 95

STATISTICS

SPSS's Neural Connection: PC Statistics Meet Gray Matter

By Craig Stinson

With Neural Connection 1.0, SPSS makes its entry into the expanding field of desktop neural-network-computing software. The \$995 Neural Connection brings neural-network technology to bear on forecasting and classification problems to which linear algorithms are either inappropriate or difficult to apply. Neural Connection should prove a valuable new arrow in the quiver of market researchers who are searching for the next great trend.

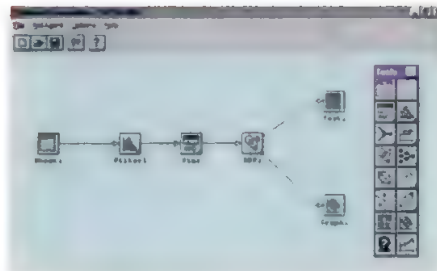
Unlike Predict (from NeuralWare), Neuralyst (from Cheshire Engineering), and Braincel (from Promised Land Software), Neural Connection is not an adjunct to your spreadsheet program. It's a standalone program that can be conveniently integrated with SPSS for Windows. SPSS users can launch Neural Connection from the SPSS menu, feed it data from an SPSS file, and funnel output back into SPSS for further analysis; the program also accepts input from Systat, all versions of Excel, and delimited ASCII files.

Neural Connection offers three neural algorithms: multilayer perceptron, which is similar to the back-propagation algorithm used by other programs; radial basis function; and Kohonen network. Neural Connection does an excellent job of preprocessing data and validating design. For example, the program's spreadsheet tool (not a traditional spreadsheet but a tabular view of training, validation, and run data) automatically checks for data-type consistency within fields and allows you to delete invalid or missing elements or replace them with mean values.

The randomize command helps remove hidden correlations in training data, while a sophisticated "what if" tool shows the sensitivity of the system to partic-

ular fields and a filter tool lets you apply more than a dozen mathematical functions to your data, as well as remove outlying values. Neural Connection also includes three traditional statistical tools (closest-class means classifier, regression, and principal-component analysis) that can help you determine whether neural techniques are appropriate.

On the downside, users who want to integrate neural analysis into applications developed in Excel may find Neural Connection less suitable than Predict or



NEURAL TOPOLOGY: Creating applications in Neural Connection is a matter of positioning tools in a valid topology. In this example, input from Sheet1 is fed through filter and simulator tools to a neural processor.

Neuralyst. And although it includes a scripting language, Neural Connection lacks Predict's capacity to generate C-based applications.

The program's accompanying booklet, Applications Guide,

provides a wealth of technical details about the program and neural-network design. Experienced hands as well as newcomers to neural computing should find this information valuable—provided they can find their way through the booklet's terse and sometimes obtuse language.

Neural Connection 1.0.

List price: \$995. Requires: 4MB RAM (8MB recommended), 4MB hard disk space, Microsoft Windows 3.1 or later. SPSS Inc., Chicago, IL; 312-329-3500; fax, 312-329-3688. Circle 408 on reader service card.

UTILITIES

PC411: Online Information, Please

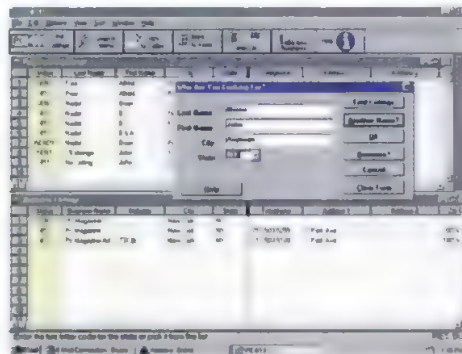
By Bruce Brown

If you want easy up-to-date keyboard access to U.S. and Canadian residential and business telephone numbers, the \$14.95 telecommunications utility PC411 for Windows 1.1 can save you time and effort.

With PC411, you start by specifying off-line the subject or company name you want to find and the city or region in which to search. When you tell the program to begin the search, it automatically dials PC411's local number and performs the search.

After about a minute, PC411 returns the results in tabular form. Since you can perform complicated queries and multiple searches during a single call from all regions in North America, using PC411 can be much more convenient than making a series of local 411 calls or long-distance-information calls to 555-1212.

PC411's 110 million listed telephone numbers and addresses are culled from all the directories available in the U.S. and Canada. PC411's listings are updated as soon as new directories are published, making the online listings more current than those in CD-ROM-based programs that are



COMPU-PHONE: PC411 lets you search for directory listings from an online directory.

updated quarterly or annually.

Though reasonably complete and current, PC411 can be expensive. Each local search, when a town or city is specified, costs 50 cents if a match is found; multiple matches for the same town don't cost extra. If you don't specify a city or town, a regional search can

cost 10 cents per listing found; there's a minimum 50 cent charge for each search.

As a result, regional searches can add up quickly, particularly if you get many matches. The program lets you set a maximum number of listings at between 50 and 1,000.

PC411's \$14.95 price is recouped quickly if you use the software, because it comes with a \$15 directory-search credit. You are encouraged to distribute copies of the program's disks to friends and colleagues, who don't need to pay for the software but don't get the initial-usage credit either.

There is no monthly service charge, so you only pay for results of searches you request. All PC411 accounts require a credit card for automated billing.

Although most CD-ROM phone directories encourage random perusing, the potential cost of casual searches discourages using PC411 just for fun.

PC411 for Windows 1.1. List price: \$14.95 (includes \$15 search-usage credit). Requires: 4MB RAM, 2MB hard disk space, Hayes-compatible modem, Microsoft Windows 3.1 or later. PC411 Inc., Inglewood, CA; 800-243-8411, 310-645-1114; fax, 310-645-1112. Circle 406 on reader service card.

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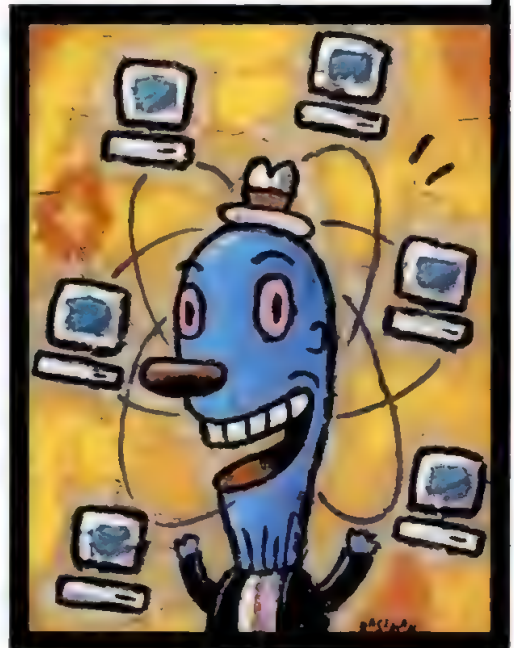
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UPGRADE CPU

At 150 MHz, Intel's Latest Pentium OverDrive Revs Up Midrange PCs

By Sebastian Rupley

Intel Corp.'s latest OverDrive processor uses the Pentium design to its fullest and is a cost-effective way to boost the speed of a 75- or a 90-MHz Pentium PC. Our tests show that the \$499 150-MHz Pentium OverDrive processor provides a significant speed boost for older Pentium systems, although its performance level lags that of an off-the-shelf 150-MHz Pentium PC.



First, check to make sure your PC's motherboard has either a zero insertion force (ZIF) socket or a self-standing Type 4 upgrade socket. Next, check with Intel to make sure your system's motherboard has been certified for an OverDrive upgrade. A list of approved systems is available on Intel's World Wide Web site (<http://www.intel.com/procs/compass/ovdr.html>) or via the company's fax-back line.



EASY AS 1-2-3: After you've opened the system case, loosen the lever on the motherboard's ZIF socket and remove the old CPU. Next, slide in the OverDrive processor and tighten the ZIF socket's lever.

The best news about the OverDrive is that it's a Pentium chip through and through. Unlike previous OverDrive processors (First Looks, October 24, 1995), this CPU doesn't carry any 486 baggage. Like the Pentium processor, the OverDrive is a superscalar CPU with 16K of internal cache that is built on a 0.35-micron semiconductor process. The OverDrive adds a built-in cooling fan and circuitry to match the basic system's operating voltage.

We upgraded a 90-MHz Pentium-based Hewlett-Packard Vectra XU system equipped with 16MB of RAM and 256K of external cache with the 150-MHz Pentium OverDrive chip. The result was a performance increase of almost 25 percent on our Winstone 96 benchmark tests compared with the performance of the 90-MHz Pentium test-bed.

The 150-MHz upgrade also bettered the performance of a basic 90-MHz Pentium system by almost 35 percent on our CPU-

mark₁₆ processor tests and by almost 30 percent on our CPU-mark₃₂ processor tests. As good as the test system's final performance was, the upgraded 150-MHz PC still lagged behind the average of the 150-MHz Pentium systems we've tested by about 8 percent on our Winstone tests and about 15 percent on our processor tests.

Is your system appropriate for a Pentium OverDrive upgrade?

The upgrade is painless and takes about 5 minutes. Just open the system's case, remove the old CPU, and plug in the new one.

Those users worried about heat dissipation with this turbocharged processor will be happy to hear that part of the Intel certification process includes a thermal analysis of the system. In addition, the 150-MHz Pentium OverDrive processor has the same ingenious on-board cooling fan as earlier

OverDrive chips. During use, a software utility monitors the CPU temperature and controls the fan.

The OverDrive costs \$499, but we expect its cost to drop during 1996. In addition, Intel has developed several additional OverDrive processors for upgrading other systems. The 120-/133-MHz Pentium OverDrive processor includes an on-board voltage regulator, plugs directly into 60- and 66-MHz Pentium systems, and sells for \$399. By summer, expect to see a 166-MHz OverDrive variant that will sell for \$679 and will boost the output of 100-MHz Pentium systems.

For PC speed demons, our benchmark tests show that the cost of any of the OverDrive CPUs and the minimal installation effort are justified, but users who can wait a few months should get the same speed boosts at rock-bottom prices. No matter when you buy, though, speed increases are obviously very competitive on a price/performance basis with more expensive, alternative upgrade options, such as increasing the system's memory, adding external cache, installing a high-end graphics adapter, or upgrading to a faster hard disk.

Right now, owners of upgradable 90-MHz Pentium systems can get a power boost from an OverDrive processor.

150-MHz Pentium OverDrive processor. List price: \$499. Requires: Upgradable Pentium PC. Intel Corp., Santa Clara, CA; 800-538-3373; fax-back, 800-525-3019; <http://www.intel.com>. Circle 434 on reader service card.

BENCHMARK TESTS

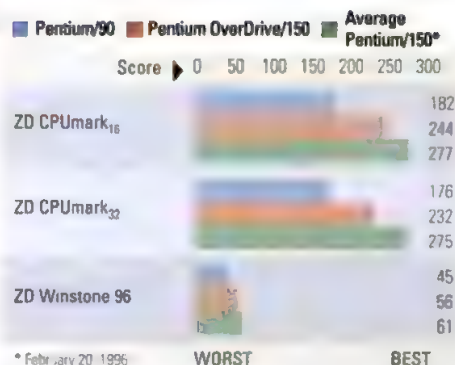


150-MHz Pentium OverDrive

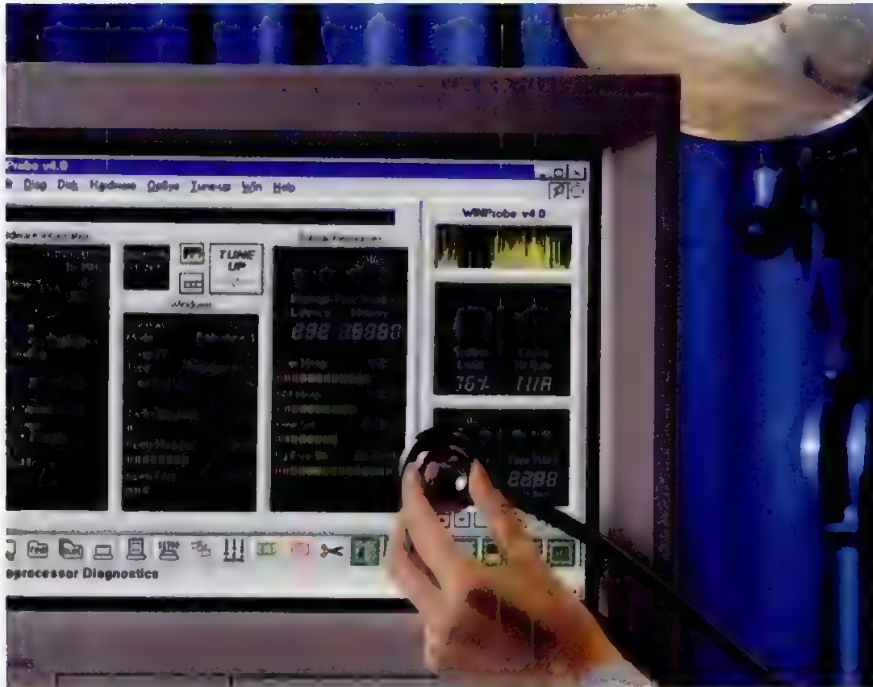
The 150-MHz Pentium OverDrive processor, which works with upgradable 75- and 90-MHz Pentium PCs, improved the performance of our 90-MHz Pentium test-bed by about 25 percent on our ZD Winstone 96 tests. It was still off the pace of the average 150-MHz Pentium PC by about 8 percent, however. The speed boosts we got over a

90-MHz Pentium system were even more dramatic on our 16- and 32-bit CPUmark processor tests.

To gauge the performance of our HP Vectra XU test PC, we used ZD Winstone 96, Version 1.0, and ZD PC Bench, Version 9.0. The system was equipped with 16MB of RAM and 256K of external cache and ran Windows 95.



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UTILITIES

PartitionMagic Streamlines And Extends Your Hard Disk

By Edward Mendelson

PowerQuest Corp.'s PartitionMagic is the only program ever created that can resize, move, and modify PC disk partitions without destroying data. This \$49.95 utility is an essential purchase for everyone who has recently bought a PC with a 1GB or larger hard disk that was formatted with a single partition.

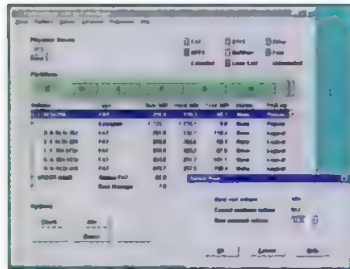
The reason it's essential is that the file allocation table (FAT) system used by DOS and Windows wastes disk space with partitions that are 1GB or larger. On a partition of 1GB or larger, every file in a FAT system uses at least 32K of disk space, even if the actual data only fills 1 byte. If you divide the disk into partitions between 512MB and 1GB, each file needs at least 16K; partitions between 256MB and 512MB use at least 8K for each file, and so on.

PartitionMagic can create smaller, more efficient partitions out of big ones in seconds, effectively freeing room for your data.

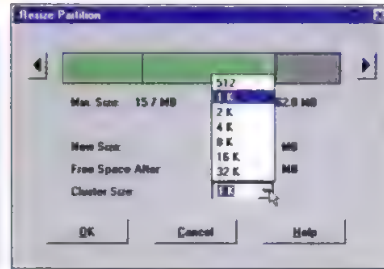
PartitionMagic comes in two versions: a \$49.95 version for Windows 95, Windows 3.x, and DOS, which we review here; and a \$69.95 model that adds features for managing OS/2 partitions (First Looks, August 1995). Both versions display a visual map of your disk's contents, including all partitions and hidden partitions, as well as non-DOS partitions and OS/2 partitions created by Windows NT, NetWare, Linux, and other operating systems.

The program can create, move, resize, delete, and reformat FAT partitions and OS/2 HPFS partitions, and it can move NTFS partitions created by Windows NT. It can also convert FAT partitions into HPFS partitions.

Because the program's operations are nondestructive (except when you delete a partition), you can't make an existing partition smaller than the files it contains.



BIGGER ROOT: PartitionMagic can increase the number of entries in the root directory to give more room for Windows 95's long filenames (left). Partition sizes can be changed by moving a bar on a graph or by entering exact sizes (right).



But you can use PartitionMagic to reorganize and streamline your hard disk thoroughly by reducing a partition to as small a space as possible and then using the previously empty disk space for data storage.

one primary partition and then expanded the extended partition and one of the logical drives inside it. The whole operation took just 4 minutes and had no ill effects on the hard disk's data.

Without PartitionMagic, the operation would have taken about 4 hours, including backing up, destroying, re-creating, and restoring two partitions and re-installing an operating system. Of course, we made sure that we backed up our disk's contents before using this powerful program, and you should do the same.

Unique, dazzling, and indispensable, PartitionMagic is a must-have program in an era of larger and larger hard disks.

PartitionMagic. List price: \$49.95. Requires: 4MB RAM (8MB recommended), DOS 5.0 or later, Microsoft Windows 3.1 or later or Windows 95. PowerQuest Corp., Orem, UT; 800-379-2566, 801-226-8977; <http://www.powerquest.com>. Circle 414 on reader service card.

WINDOWS UTILITIES

SuperPrint 4.0: The 32-Bit Printing Alternative

By J.W. Olsen

Zenographics' \$99.99 SuperPrint 4.0 replaces Windows' 16-bit printing subsystem with a robust 32-bit alternative and ships with versions for Windows 3.x, Windows 95, and Windows NT. If a large part of your day is spent processing volume printing, SuperPrint's powerful and flexible printing controls may make life a little easier.

The heart of SuperPrint is its user interface, SuperQueue, from which you control all your local and network printers. You can pause and activate printers and individual documents. Documents also can be promoted or demoted within a queue.

A big help is the ability to preview pending print jobs, though during evaluation we were unable to preview some graphics formats. As each job prints, SuperQueue displays extensive status information.

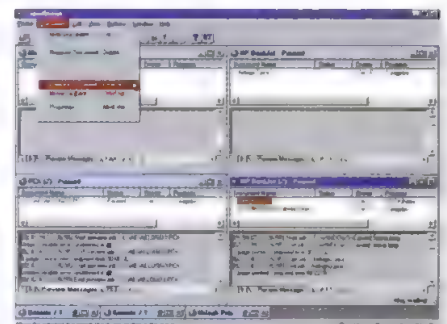
New to SuperPrint 4.0's features for Windows 95 and Windows NT is the ability to drag and

drop bitmapped graphics files directly onto SuperQueue without invoking an application. Unfortunately, on a PC equipped with Windows 95 and 8MB of RAM, this feature effectively took control of our system until the graphics printed. The problem, which was acknowledged by Zenographics, disappeared when we increased the amount of RAM to 12MB.

Like those in HiJaak 95, SuperPrint's drivers can redirect printer output from applications to bitmapped or PostScript files. Unlike Windows, SuperPrint sends files across Windows-compatible networks in a resource-saving compressed EMF format. Finally, SuperPrint offers a variety of user adjustments that can significantly enhance its output, especially its graphics output.

If you manage volumes of

printing and your non-PostScript printer is supported, SuperPrint can help tame your work, enhance output quality, and—with a sufficient amount of RAM—speed up your system's all-around responsiveness.



PRINT ON DEMAND: SuperPrint 4.0 provides extensive user options and status information.

SuperPrint 4.0. List price: \$99.99. Requires: Microsoft Windows 3.x with 1MB hard disk space or Windows 95 or Windows NT with 3MB hard disk space. Zenographics, Irvine, CA; 800-366-7494; fax, 714-851-1314. Circle 413 on reader service card.



INTRODUCING QEMM 8. MORE MEMORY, MORE MEMORY, AND STILL MORE MEMORY FOR WINDOWS 95, WINDOWS 3.1 AND DOS.

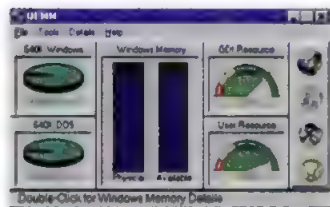
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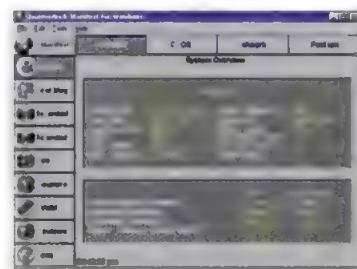


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other areas of memory. This doesn't just make your programs and games under the DOS prompt scream right off your screen, it gets Windows the memory it needs.

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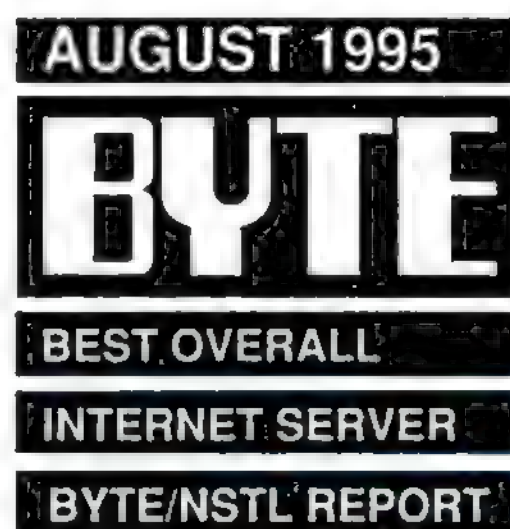
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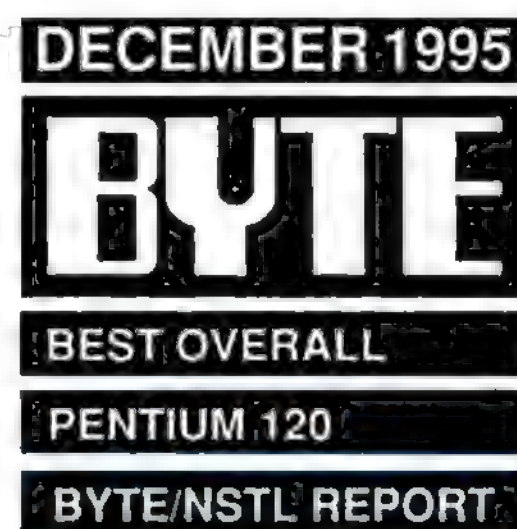
February 20, 1996
SAG STF 166 Pentium



February 20, 1996
SAG STF 150 Pentium



Internet Server SFT Alpha



120MHz Pentium STC 120

"SAG is the clear leader in our price/performance scale. Both systems were top notch performers turning in the best Winstone 96, Graphics Winmark 96 and Disk Winmark. Both are loaded with powerful components."

PC Magazine

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COLOR SCANNERS

HP ScanJet 4p: High-Quality Color Flatbed Scanning at a Personal Price

By Alfred Poor

As recently as two years ago, a scanner that could produce 24-bit color scans at optical resolutions up to 300 dots per inch (dpi) in a single pass for up to legal-size originals would have cost thousands of dollars and would have been aimed at graphics professionals. Today, Hewlett-Packard Co.'s \$499 HP ScanJet 4p fills that bill.

The ScanJet 4p may have professional-quality specifications, but it is clearly aimed at home and office users. Designed to compete with page-fed personal scanners that cost slightly less, the ScanJet 4p tries to make it as easy as possible to get digital images into your documents.

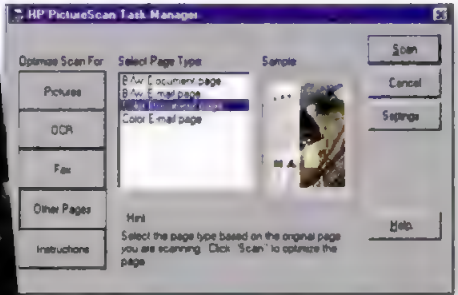
The ease-of-use quotient is increased through the use of Visioneer's software, PaperPort, which is used on that company's page scanner, the PaperPort VX, and HP's page scanner, the ScanJet 4s (First Looks, January 9, 1996). This Windows program uses a desktop metaphor to make it easier to work with and annotate scanned images.

PaperPort uses OLE 2.0 to create links with Windows applications so that you can drag and drop scanned images to icons for word processing, graphics, faxing, or other programs. PaperPort, which has application-specific links for about 100 popular programs, knows what type of data to pass along to the different programs. For example, PaperPort will perform optical character recognition (OCR) using OmniPage Lite before passing the document's image to Word for Windows.

The Twain scanner software is easy to use with Windows programs. The interface for this driver is greatly simplified; you don't have to deal with choosing brightness, contrast, color depth, or

adapter. A handy test utility quickly verifies that the unit is working correctly.

The scanner includes calibration features for both your moni-



got badly scrambled. Type styles and point sizes were not retained, though bold characters were correctly formatted.

For graphics, the scanner took 102 seconds to scan a 5- by 7-inch color photograph at 200 dpi and 24-bit color depth and transfer the image from the Twain driver to PaperPort; the scan itself took about 23 seconds. These speeds are considerably slower than

AUTO-ADJUST: All you have to do is pick the type of document and the ScanJet's software automatically chooses the best settings (above). The bed of the HP ScanJet 4p can handle up to legal-size originals, and with the system's automatic settings, we achieved rich and accurate scans.

even resolution settings.

Instead, you pick the type of source document based on its purpose, such as fax, OCR, pictures, or other types of documents. Next, pick the type of output device you will be using. The software automatically chooses the best setting based on your selections.

Some users will find this automated configuration process confining. On the whole, the ScanJet 4p's software made excellent choices on our behalf over a variety of originals. We found that we could trick the software into changing these settings by selecting just a portion of the image and then enlarging the scanned area while holding down the Ctrl key to prevent changes in the exposure settings.

Installation is simple. A Quick Setup brochure has separate instructions for Windows 3.x and Windows 95 installations. You first install the software and then either connect the scanner to an existing SCSI adapter or to the included 16-bit ISA SCSI-2

tor and your printer. The printer-calibration process creates a target that you print and then scan; the software then automatically adjusts itself based on the image.

In addition to PaperPort, HP also includes two useful programs: Corel PhotoPaint Version 5.0 Select, which is a feature-limited version of the sophisticated image-editing software, and HP's ScanJet Copy Utility, which makes it easy to produce copies of documents using your scanner and printer.

On our tests, the scanner and its software were clearly up to the task of general home and business scanning. It took about 35 seconds to scan a full page of text and another 51 seconds to perform OCR with OmniPage Lite and open the document in Word for Windows. Thanks in part to HP's AccuScan technology, the character recognition was nearly flawless on 12-point type and did an excellent job on 8-point text as well. Simple snaking columns were read correctly, though columns that included boxed text

those posted by the more expensive HP ScanJet 4c (First Looks, December 19, 1995), which is designed for the needs of more sophisticated users.

For the typical business user, however, the ScanJet 4p is well suited for a wide range of text and image applications: From performing OCR on paper mail to grabbing images for reports to feeding hard-copy originals to your fax modem, this device makes the doing easy. And at a price that approaches that of single-sheet personal scanners, you get a full-size flatbed that can handle books, magazines, and other bound materials.

HP ScanJet 4p. Estimated street price: \$499. Requires: 8MB RAM, 20MB hard disk space, Microsoft Windows 3.1 or later, available ISA expansion slot or ASPI- or CAM-compatible SCSI interface. Hewlett-Packard Co., Direct Marketing Organization, Santa Clara, CA; 800-722-6538, 415-852-1500; fax, 800-333-1917. Circle 433 on reader service card

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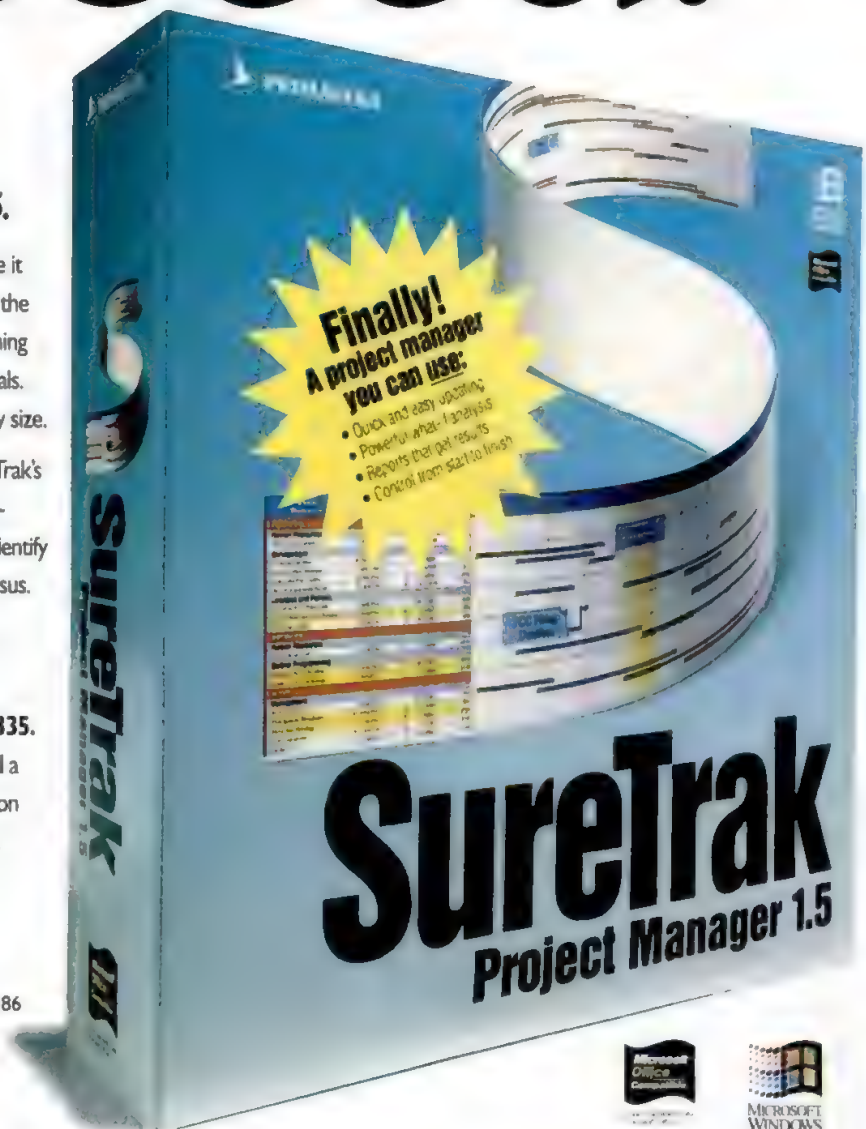
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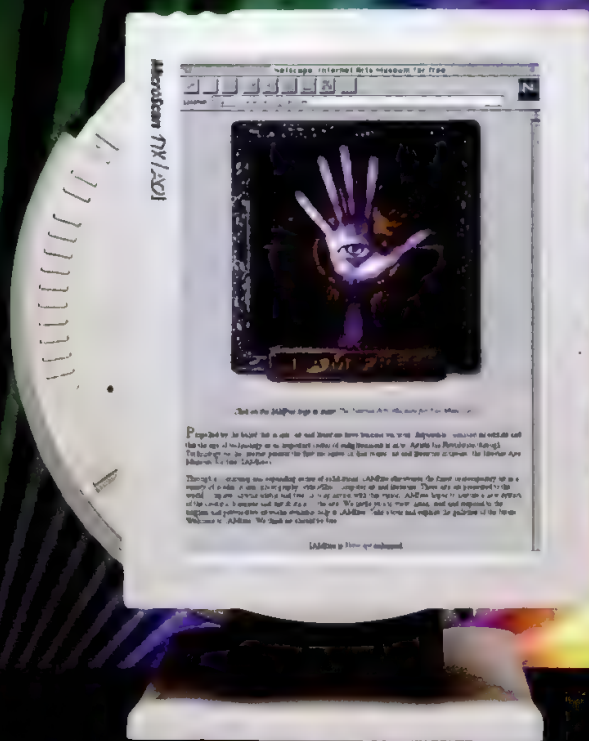
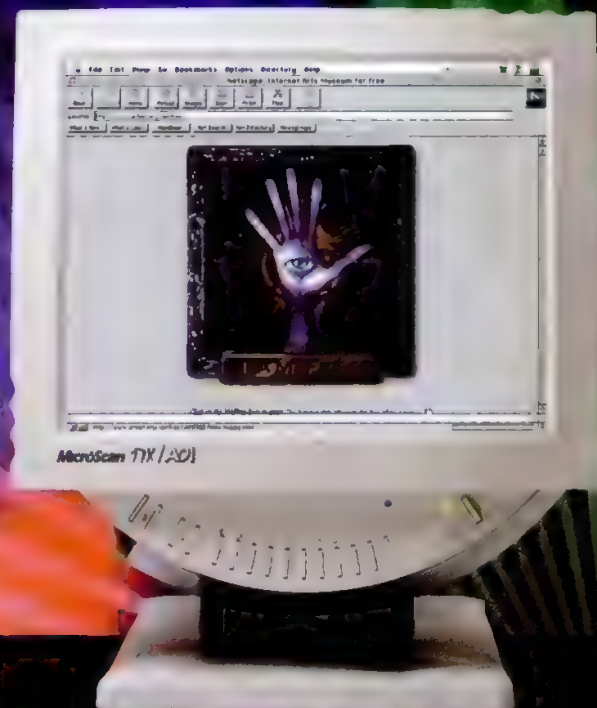
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CIRCLE 226 ON READER SERVICE CARD

MULTIMEDIA UPGRADES

A Trio of 3-D Audio Enhancers That Will Have Your Multimedia PC Surrounded

By Bruce Brown

If you want to enhance the impact of presentations on your computer or if you just want better sound when you listen to audio CDs or play games, the addition of 3-D sound effects can provide dramatic improvement. Sometimes integrated on motherboards, 3-D sound circuitry is also available on sound cards or in computer speaker systems.

In case you already have a multimedia system that you like, three companies now offer 3-D sound enhancers that plug in between your audio card and amplified speakers to add depth and width to sound. Labtec, NuReality, and Philips Key Module each sell 3-D plug-in boxes that come with sound-width controls, stereo line-in and line-out jacks or wires, and separate AC adapters.

These devices improve sound by using psychoacoustic techniques to manipulate sound clues coming from two ordinary speakers. The impression the listener gets is that sound is emanating from speakers spaced farther apart than the actual units and in some cases, even behind the listener. The two technologies employed by these devices, Spatializer Audio Laboratories' Spatializer Audio Processor (used in the Labtec Imager and Philips Incredible Sound) and SRS Labs' SRS circuitry (used in NuReality's Vivid 3D Proex), work with all input sound, and neither requires specially encoded original material, in contrast to Dolby Pro Logic, THX, and Q Sound.

LABTEC IMAGER

Easily the least expensive of the three devices, the \$39.99 Labtec

Imager also requires the least desk space. The Imager's off-white case measures 4.1 by 1.6 by 5.2 inches and rests on tiny feet, fitting easily next to a monitor on top of a system unit. The Imager also gives the most bang for the buck if you're just looking for simple 3-D enhanced sound.

gain of the units we reviewed.

Labtec Imager. Estimated street price: \$39.99. Requires: Audio device with stereo line-out plugs and powered speakers. Labtec, Vancouver, WA; 360-896-2000; fax, 360-896-2020; <http://www.labtec.com>. Circle 403 on reader service card.



AURAL ADD-ONS: Three new methods of improving your PC's sound quality include NuReality's Vivid 3D Proex (left), the Labtec Imager (right, top), and Philips Key Module's Incredible Sound (right, bottom).

A single cord plugs into your audio card's line-out jack to transmit a stereo input signal to the Imager, and there are two stereo line-out jacks. A Y-adaptor is included in case your speakers use a single plug. The Imager also has a three-dimensional-effect on/off switch with an indicator light on the front, and a control knob to adjust the perceived three-dimensional-signal width. The control knob can also be set to handle mono audio signals.

On tests with audio CDs and computer games, the Imager produced clear sound with noticeable added audio depth. If what you're looking for is better sound, the Imager's low price makes it the bar-

NUREALITY VIVID 3D PROEX

NuReality's \$109.95 Vivid 3D Proex, the largest of the group at 8.0 by 5.3 by 5.3 inches, also has the greatest number of controls and more variable 3-D effects. The Vivid 3D Proex, which is in the middle of the group in terms of price, is a clear step above the others in the control it gives users over audio enhancement.

The Vivid 3D Proex has single stereo line-in and line-out jacks on the back panel. A power switch is located on the front, as are controls for volume, Space (which adjusts the width of the audio signal to fit the size of the listening space), and Center (which adjusts the frequency

range of the signals that appear to be in the aural center of the 3-D stereo field). The Vivid 3D Proex also has an SRS on/off button and a mono/stereo switch. An LED signal-width indicator shows how wide the signal is at a given time.

The ability to adjust volume, sound width, and center-channel content lets you tailor the sound to your listening environment, personal listening preferences, and different types of audio content. The unit didn't color or mute the sound and is clearly the most flexible of the three products in this miniroundup.

Vivid 3D Proex. List price: \$109.95. Requires: Audio device with stereo line-out plugs and powered speakers. NuReality, Santa Ana, CA; 800-501-8086, 714-442-1080; fax, 714-852-1059. Circle 404 on reader service card.

PHILIPS INCREDIBLE SOUND

Philips Key Module's \$149 Incredible Sound is the newest and the most expensive of the three units. It also has the smallest case, measuring just 1.5 by 4.2 by 4.4 inches. Unfortunately, the Incredible Sound has the fewest controls and the most primitive design, and the test unit seemed to mute or deaden the sound.

Available both as the tested external unit or as an internal \$89 PC board, the Incredible Sound has stereo line-in and line-out jacks and a single knob to adjust the width of the stereo signal. There is no power switch or 3-D on/off switch. The maroon box itself is nearly square, with a relatively large gray control knob.

The Incredible Sound's 3-D effect is similar to that produced by the Imager, but because of its high price, low degree of user control, and slight sound deadening, this unit pales in comparison with the two other add-ons.

Incredible Sound. List price: External, \$149; internal, \$89. Requires: Audio device with stereo line-out plugs and powered speakers. Philips Key Module, San Jose, CA; 800-235-7373, 408-453-7373; fax, 408-453-6444. Circle 405 on reader service card.

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Recently, Stephen Taylor of North Carolina accidentally backed his car over his Dell Latitude XPi notebook. Don't ask. These things happen.

But as amazing as it may seem, his Dell Latitude notebook booted up immediately and sustained only minor damage. The moral of the story: if you really want a notebook that can stand up to the rigors of the real world, get a Dell Latitude.

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SCSI

Apcon's SCSI Booster Puts SCSI Exactly Where You Need It

By James Karney

Apcon's ACI-2016 SCSI Booster not only offers a remedy for tricky SCSI cabling problems; it also improves signal quality and reduces cable noise so that the effective length of a typical device chain can be potentially doubled. Priced from \$295 for a Narrow SCSI model to \$395 for a 68-pin edition suitable for use with Wide SCSI devices, the SCSI Booster charges a small price for this convenience and reliability.

One of the major attractions of connecting peripherals with a SCSI host adapter is the ability to cable up to 32 devices on a 6-meter daisy chain. That upper limit drops in half to 3 meters for a Fast SCSI chain and to 1.5 meters if you use the new Ultra SCSI standard. And if any cable segment is not of top quality, the effective range can be dramatically reduced.

The SCSI Booster is a small box about the size of a deck of cards that acts as a tiny relay station, intercepting each SCSI command and transferring it at full signal strength in less than 15 nanoseconds. Since it doesn't need a SCSI ID, the SCSI Booster doesn't reduce the number of peripherals that can be attached to an adapter.

The SCSI Booster comes in three connector types: 50-pin Centronics, and 50- and 68-pin d-shell plugs. All are available in internal and external styles. There are matching female SCSI connectors on two sides, an external power supply, and an LED to indicate SCSI bus activity.

Attaching the unit is simple: Plug it in between two devices on the chain. The only settings are a pair of termination DIP switches, which are almost always left in the default position.

We set up a SCSI chain on a Windows NT server with an in-

ternal 4GB Ultra SCSI drive and a Plextor 6X CD-ROM drive attached to a QLogic 1020 host adapter. First, we added two CD-ROM drives, a Pioneer DRM-624X jukebox, a Sony CD-Recorder, and an HP ScanJet IIIc to the external connector until the chain failed. Adding an ACI 2016 SCSI Booster between the first and second external devices solved the problem, and all the



STRONG SCSI: Apcon's ACI-2016 SCSI Booster brings SCSI commands to full signal strength for increased reliability.

peripherals worked well.

In addition, we were able to get up to three times the normal length of cable to work by linking two SCSI Boosters to the line. This can be really useful for placing products such as scanners and tape drives far from the PC that contains the host adapter, or when constructing large server-

based disk arrays. Apcon says that you can use up to three SCSI Boosters on a chain.

There are no absolutes when it comes to SCSI cabling. Apcon's SCSI Booster, however, is a useful tool for integrators who need to build reliable systems that exceed traditional SCSI specifications, or those who want that extra insurance as they approach its limits.

ACI-2016 SCSI Booster. List price: \$295 to \$395, depending on connector type. Requires: SCSI host adapter. Apcon Inc., Wilsonville, OR; 800-624-6808, 503-685-9300; fax, 503-685-9099. *Circle 401 on reader service card.*

PRESENTATION ADD-ONS

Compadre: The PowerPoint User's Best Friend

By Barry Simon

If you feel your PowerPoint presentations lack punch and originality because they've been built with off-the-shelf PowerPoint components, take a look at Three D Graphics' Compadre. The \$49.95 program features tight integration with PowerPoint 7.0 and Windows 95; a plethora of textures, fills, and

dialog box. This box contains Windows 95 shortcuts to the included 136 templates on the Compadre CD-ROM. It also adds shortcuts to the CD in the Windows 95 Favorites folder.

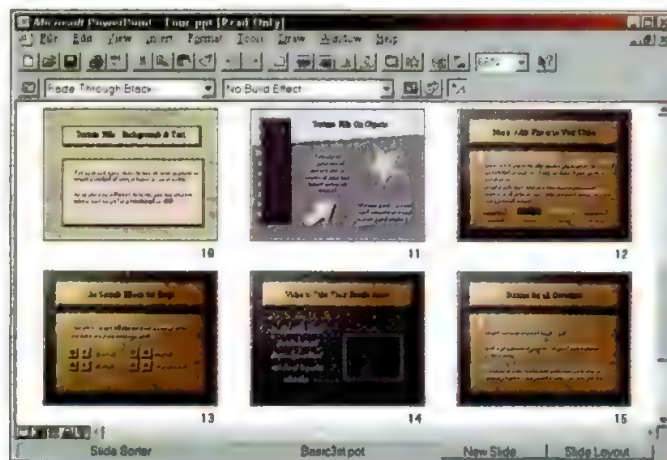
These shortcuts are big time-savers. We found that when we wanted to select new textures on the Compadre CD-ROM, we could access them from the

PowerPoint 7.0's new features. For example, the CD-ROM has more than 130 textures that can take advantage of PowerPoint's ability to use textured backgrounds and fills. In addition, PowerPoint now lets you embed action buttons, and Compadre has more than 1,400 buttons with 27 backgrounds and varying symbols, symbol colors, and sizes. There is also a collection of sound effects, music clips, and videos that can help spice up a run-of-the-mill presentation.

Compadre has two tools that provide a compass in this veritable sea of content. There's a 48-page booklet with color samples that lets you home in on the template or button style that suit a particular project. And the CD-ROM has a 5MB help file with even more samples.

Ironically, Compadre's content looks so good on a 64,000-color display that you may be disappointed with its appearance on your 16- or 256-color notebook. Regardless of how you use the program, Compadre's sensible design and interface and its stellar content bring PowerPoint to a new level.

Compadre. List price: \$49.95. Requires: 4MB RAM, 10MB hard disk space, Microsoft Windows 95, PowerPoint 7.0, CD-ROM drive. Three D Graphics, Los Angeles, CA; 800-913-0008, 310-553-3313; <http://www.threedgraphics.com>. *Circle 402 on reader service card.*



NEW POINT OF VIEW: Compadre provides a variety of original templates and buttons for stunning presentations.

buttons; and excellent help and documentation.

Compadre's default installation adds a tab for the program to PowerPoint's New Presentation

Office 95 Open/Insert dialog box. All we had to do was click the Favorites button and then the shortcut to Compadre Texture Fills.

Compadre exploits two of

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ABC Graphics Suite



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First Looks

LCD PANELS

MultiSync LCD200: Thin Is In

By Alfred Poor

You're likely to have a hard time finding a thinner and lighter desktop monitor than NEC's 3-inch-thick MultiSync LCD200, whose screen measures 12 inches diagonally and whose weight comes in at just 9 pounds 8 ounces.

The monitor uses active-matrix liquid crystal display (LCD) technology for a bright, flat screen with high contrast. Unlike other desktop LCD monitors, which often require proprietary graphics adapters, the LCD200 works with any standard VESA graphics adapter.

The screen has a physical resolution of 1,024 by 768 pixels and provides sharp, flawless images. Lower-resolution images, such as 800-by-600 and 640-by-480, require some pixel duplication, which results in a less attractive image.

A standard analog signal is used by the LCD200, which means that there effectively is no limit to the number of colors that can be displayed simultaneously. We tested the unit at a resolution of 1,024-by-768 and 65,536 colors, and the results were nothing short of gorgeous.

Front-panel controls provide access to on-screen configuration menus; the controls are straightforward and intuitive. The unit has a tilt mounting that lets you adjust the viewing angle. And because the monitor is so light, there's no need for a swivel mount on its base; just slide the LCD200 to the position in which it looks best.

Rated at a viewing angle of up to 20 degrees off perpendicular in the vertical plane and 30 degrees in the horizontal plane, the LCD200 provides the viewing space of a typical 14-inch monitor. The only weakness is that the panel's backlighting was uneven, making the image less uniform than that of a typical cathode-ray-tube (CRT) monitor. On the

other hand, the totally flat screen and lack of any of convergence or focus problems found in practically all CRT monitors gave the LCD 200's display an outstanding level of clarity.

The LCD200 complies with VESA power management signal specifications and consumes less than 4 watts in sleep mode. Even when operating at full power, it consumes just 30 watts, which is about one-third the power consumption of a comparable CRT model. And since its



MOVABLE SCREEN: At less than 10 pounds, the LCD200 can fit in on any desktop.

LCD technology emits practically none of the low-frequency electromagnetic radiation associ-

ated with CRT designs, it easily complies with MPR II and FCC Class B emission standards.

The kicker with the LCD200 is the sticker; its estimated street price of \$3,999 is about ten times the price of an equivalent CRT monitor. As a result, the innovative LCD200 will probably appeal to those buyers who are concerned about emissions or space limitations or to those who just want to have the coolest display in the company. **MultiSync LCD200.** Estimated street price: \$3,999. NEC Technologies Inc., Boxborough, MA; 800-632-4636, 508-264-8000; <http://www.nec.com>. Circle 407 on reader service card.

COLOR PRINTERS

Citizen Printiva 600C: Photorealistic Color for Less

By M. David Stone

Using a novel printing technology, Citizen America Corp.'s \$599 Printiva 600C has the ability to produce stunning 600- by 600-dot-per-inch (dpi) photorealistic output with 16.7 million colors, or 1,200 by 600 dpi in black and white.

The Printiva's micro dry process is similar to thermal dye and thermal wax printing technology, because the pigment is stored on a ribbon and is transferred to paper with heat. Instead of wax or dye, however, the Printiva's ribbons hold a resin-based ink that consists of ultrafine particles. The printer moves the particles from ribbon to paper and fuses them to the paper with a combination of heat and pressure.

Unlike thermal dye and thermal wax printers, the Printiva uses an individual half-inch-wide ribbon for each color. When you print a file, the Printiva runs the page through the printer once for each color, but it uses only as much of each ribbon as is neces-

sary instead of a full page's worth of each color.

Using relatively little ribbon and printing on plain paper helps keep the per-page cost at between 20 cents for 25 percent coverage and 80 cents for full-page coverage. That's a significant savings compared with the typical \$1 to \$1.50 price per print for thermal dye printers.



On our tests, we found that output on standard copier paper suffered from lots of white specks showing up on the page. When we used laser paper, which Citizen recommends, the white specks disappeared. Test prints had rich, saturated colors and sharp edges.

Citizen stresses that the Printiva is meant specifically for photos, as opposed to graphics or

text. But surprisingly, on laser paper the Printiva 600C was quite good at each. The downside is that the Printiva printer is a bit slow, managing only 27 characters per second on *PC Magazine's* Print Speed test.

Don't be swayed by the slow text speed. The more important issue is that color photos print much faster on the Printiva than they do on the most inexpensive thermal dye printers, which cost twice as much as the Printiva. Most important, for the same price as an inexpensive thermal dye printer,

PHOTO PRINTER: The Citizen Printiva 600C is compact and produces photorealistic prints.

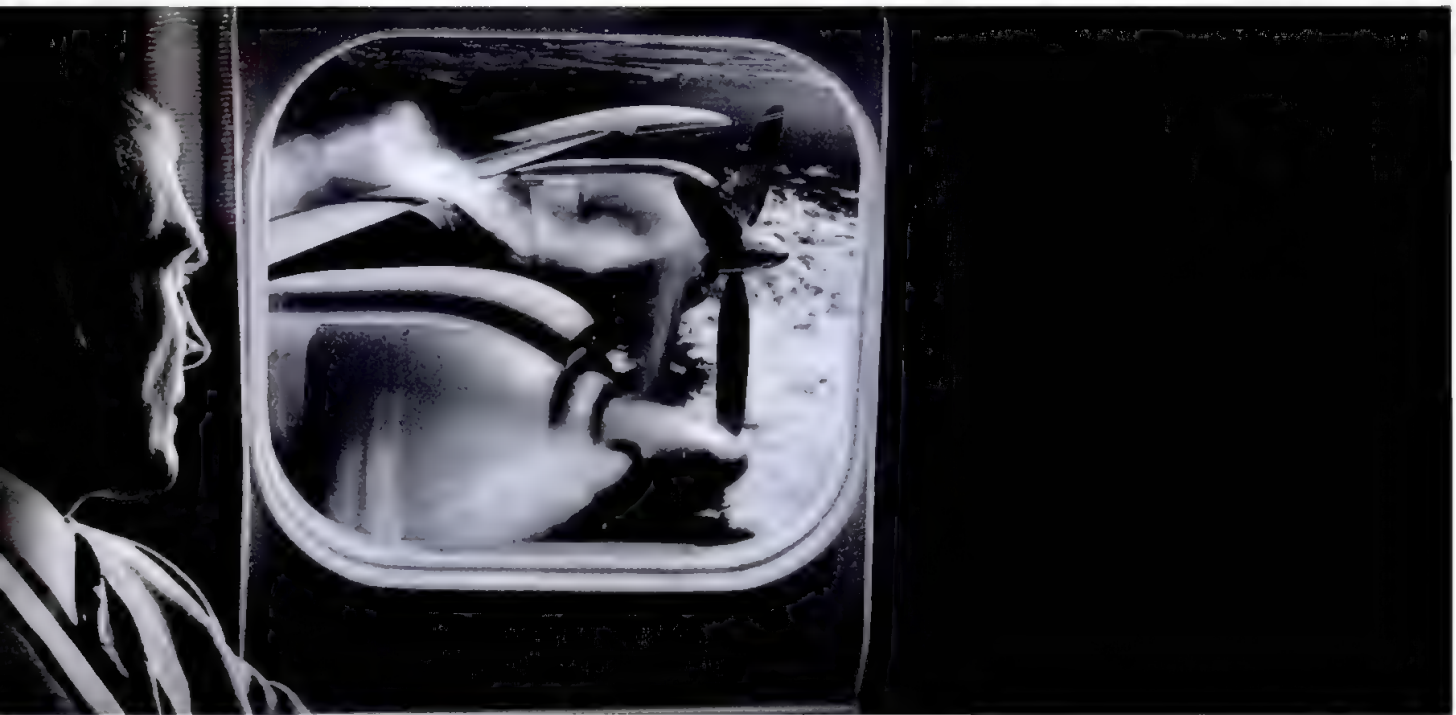


you can buy both the Printiva and an ink jet printer, thus allowing you to print text on the ink jet printer and photos on the Printiva.

Citizen Printiva 600C. List price: \$599. Requires: 4MB RAM, 5MB hard disk space, Microsoft Windows 3.1 or later or Windows 95. Citizen America Corp., Santa Monica, CA; 800-477-4683, 310-453-0614; fax, 310-453-2814. Circle 409 on reader service card.

COMPAQ

Has It Changed Your Life Yet?



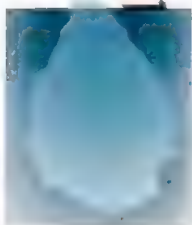
The problem with trouble is that usually by the time you find out about it, it's too late. Not so with Compaq Intelligent Manageability. Compaq Intelligent Manageability is a superior collection of preinstalled features and tools found only on the Compaq Deskpro. Together, they work to detect and eliminate a variety of potential problems on your network before they become real ones. Fault Management features like our IntelliSafe drive, which not only notifies you of impending failure but also backs itself up, minimizing loss of mission-critical data

YOU'RE FLYING ALONG AT 25,000 FEET WHEN SUDDENLY
THREE OF THE ENGINES QUIT. NOW WOULD BE A GOOD
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and PC downtime. And Asset Management, whose features help you keep track of hardware and software across the network from the comfort of your desk. Because all the information you need can be delivered remotely to your PC. Compaq Intelligent Manageability also includes a wide range of security features designed to keep your network secure. Which all adds up to providing the best and most comprehensive solution for managing PCs and predicting trouble on your network. Because when there's trouble, don't you want to know about it—before it happens?

OUR SINCERE APPRECIATION TO THOSE OTHER PROGRAMS FOR CONTINUING TO DELETE FILES THAT WERE NEVER MEANT TO BE DELETED.

Only UnInstaller™ from MicroHelp gives you absolute peace of mind to safely clean-up your hard drive. With its exclusive SmartLinks™ technology, UnInstaller performs an intelligent series of scans on your hard drive until it thoroughly understands the inter-relationships of files and programs. Without this technology, even an experienced user may find it easy to accidentally remove a crucial file.

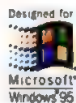


It's what you don't see on your hard drive that causes problems. Every application puts bits and pieces of itself in places you don't know about. Without UnInstaller, things can slow down — or come to a screeching halt.

And, as an added safety net, UnInstaller automatically compresses and backs-up everything it removes. So, as you clean off bits and pieces of old files, you can take comfort in being able to put things back exactly as they were with the simple click of a button.

Of course, with other deletion programs you can have the experience of getting rid of things you never meant to get rid of.

Which may be good for us, but bad for you.



Despite popular belief, Windows 95 applications aren't very thorough at automatically removing themselves from your hard drive. Regardless of which version of Windows you use, you need UnInstaller to continually clean things up. UnInstaller Works with both 16-bit and 32-bit applications.



Why take your chances with just any old clean-up program? UnInstaller is the No. 1-selling Windows utility on the market with more than a million copies sold.



1-800-922-3383

Available at your local software store.
MicroHelp is at www.microhelp.com

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CIRCLE 214 ON READER SERVICE CARD

MicroHelp

HEY, EVERYONE CAN USE A LITTLE HELP.

Second Looks

LIVING WITH THE PRODUCTS WE REVIEW

By Brian Nadel

DESKTOP PUBLISHING

PageMaker 6 Becomes a Page Stopper

IF YOU'VE HAD PROBLEMS printing from PageMaker 6 (see First Looks, January 23, 1996), you may be working with an out-of-date set of ODBC drivers for the PageMaker database Plug-In.

If you see one of the following error messages while the program is drawing the printer dialog box on the screen, you probably need to replace the existing drivers with new ones: KERNEL32.DLL, ODBC32.DLL or KRNL386.EXE. Start by renam-



ing the drivers contained in the ODBC32.DLL file as ODBC.OLD, just in case you need them later. Then restart Windows 95 and install the new ODBC.DLL file in the TechInfo Directory of the PageMaker 6.0 CD-ROM; there's a step-by-step wizard that makes it easy to install.

At this point, you should be able to print anything you see on screen without a problem.

LASER PRINTERS

Getting the Shock Treatment From Some Panasonic Printers

IN OUR LAST ANNUAL PRINTER ISSUE, WE GAVE THE PANASONIC KX-P6100 laser printer an Editors' Choice award for its innovative upright design and ability to render crisp text and graphics (see "A Sharper Image," November 7, 1995). Since then, a batch of Panasonic printers, including the KX-P6100 and KX-P6500 models, left Panasonic's factories in Japan and Malaysia improperly assembled, so that if they're not properly grounded, the printers could give users a jolt.



The potential shock is caused by the fuser's power supply wires, which can short out on a metal conduit plate. To see if your printer could have this defect, check the box the printer came in and the printer itself for a colored dot affixed after inspection. If neither your box nor the printer have a dot, it may not have been fully inspected.

Call Panasonic at 800-328-6394 for a free on-site inspection. If the technician finds that your printer is defective, it will be replaced. All those who participate in this inspection will receive a free toner cartridge for their printer.

DIGITAL PHOTOGRAPHY

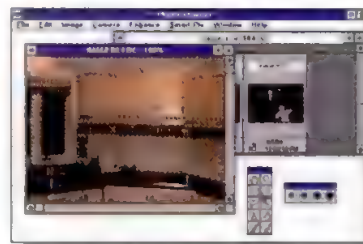
A New Face For Digital Cameras

OVER THE PAST SEVERAL months, the Second Looks mailbag has contained many letters about readers' experiences—good and bad—with the current crop of inexpensive digital cameras. One in particular, from Karen Frederick, praised the Kodak DC-40's ease of use but noted that she was disappointed by the image software that came with it (see First Looks, June 13, 1995).

The problem is that the PhotoEnhancer image transfer and editing program, which was written by PictureWorks Technology, refused to move photos from the camera into her PC about one-quarter of the time. When she restarted the software, the transfer went without a hitch.

Now Kodak and Picture-

Works have revamped the PhotoEnhancer software to make image downloads a bit more reliable, and along the way they rewrote the underlying compression technique for



greater performance. Version 1.7 of PhotoEnhancer will be mailed to all DC-40 registered users.

Under a variety of conditions and systems we found that the PhotoEnhancer update worked without fail, moving dozens of images from camera to PC.

BUG BRIEFS

PROBLEM

SOLUTIONS

► Sometimes PC Cards can get jammed in Apple PowerBook notebooks. The card-ejection system relies on a nickel-titanium wire, which contracts when a voltage is applied to it, sometimes causing the card to jam.

Insert the end of a paper clip into the small hole next to the card slot to eject the card manually. If this doesn't work, try pulling it out with your fingers, pliers, or forceps. Be careful not to damage the card and reset the balky mechanism by inserting a paper clip.

► If you try installing Notes on a Windows 95 client with a drive compressed using Microsoft's compression program, you may get a message that there isn't enough hard disk space or there's a problem with the drive.

There is a known problem with some builds of Notes. You can avoid this bottleneck by installing the software directly to the client over your network.

LOOKING AHEAD

Tell me what you love and hate about these products, and we'll share the information in future issues: Apple PowerBook 5300 • Color laser printers • Flowcharting pro-

grams • IBM ThinkPad 760 CD • LANtastic for OS/2 • Microsoft Office • Multifunction peripherals • Quad-speed CD-ROM drives • SmartSuite 96 • SoftWindows • Windows 95

Utilities • WinFax PRO 7.0. Contact Brian Nadel directly via MCI Mail (556-1500), CompuServe (72241,1616), or on the Internet at bnadel@zd.com.

ILLUSTRATION BY TIMOTHY CARROLL; PHOTOGRAPH BY THOM CONNOR



WHAT'S THE POINT OF BUYING A NOTEBOOK THAT TRAVELS IF YOU DON'T HAVE ANY MONEY LEFT TO TRAVEL?

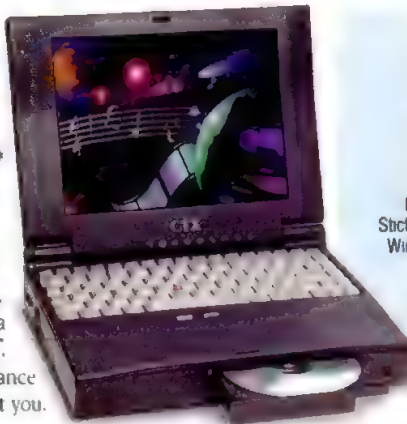
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New & Improved

NEWS OF ANNOUNCED PRODUCTS AND UPGRADES

By Melissa J. Perenson

Drawing on Experts

SO YOU WANT TO CREATE PROFESSIONAL-LOOKING GRAPHICS without having to learn the complexities usually associated with drawing software? Claris Corp.'s \$130 **ClarisDraw for Windows** makes graphical drawing accessible to most users by bridging the gap between advanced users who need applications such as CorelDraw and more basic users who want versatility without too much complexity.

A 32-bit application, ClarisDraw handles everything from technical illustrations and floor plans to diagrams, basic desktop publishing, and free-form art. The features include alignment and connection tools, a library with over 2,400 clip-art elements, color painting, image enhancement, a variety of advanced text effects, and drag-and-drop support; OLE 2.0 is not supported.

Claris Corp., Santa Clara, CA; 800-544-8554, 408-727-8227; <http://www.claris.com>. *Circle 415 on reader service card.*



A Natural Evolution

MICRON ELECTRONICS finally joins the multimedia-notebook fray with one of the most intelligently designed notebook PCs available today.

The **Micron Millennium TransPort** is available with either a Pentium 120- or Pentium 133-MHz chip (the P/120 starts at \$3,999, the P/133 starts at \$4,999) and with your choice of an 810MB or a 1.3GB removable hard disk. Also standard are 16MB of RAM, a quad-speed CD-ROM drive, a 3.5-inch modular floppy disk drive, a Type III PC Card slot, and an 11.3-inch Super VGA display.

The 6.9-pound Millennium Trans-



Port also includes stereo speakers embedded in the comfortable palm rest, a PCI 64-bit graphics accelerator with 1MB of DRAM, S-Video and NTSC video outputs, and microphone and stereo line-in and line-out jacks. There are two modular expansion bays, 256K of pipelined-burst L2 cache, and two infrared ports, one each in the front and the rear of the unit. The system comes with both a pointing stick and a touch pad. A sleekly designed multimedia port replicator costs \$299.

Micron Electronics Inc., Nampa, ID; 800-438-3343, 208-893-3434; fax, 208-893-3424. *Circle 417 on reader service card.*

For Frequent Fliers...

FOR THOSE OF YOU NOT ON CompuServe or The Microsoft Network, United Airlines Corp. is now offering a \$24.95 disk-based version of its **United Connection**; online access to the service is free.

Armed with an easy-to-navigate interface, United Connection

lets you connect directly into United's Apollo reservations system, search for

the fares and flights that you want, and purchase your tickets online. While you're at it, you can also make arrangements with more than 500 other airlines, 30,000 hotel properties, and 50 car-rental agencies.

United Airlines Corp., Elk Grove, IL; 800-482-2696. *Circle 416 on reader service card.*



PHOTOGRAPH BY THOM D'CONNOR

HOT PROSPECT

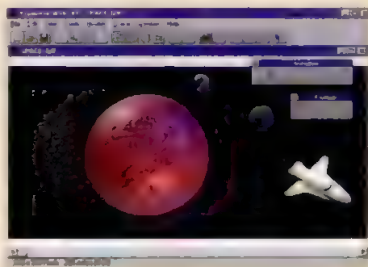
The Three-Dimensional Web

Want to give your World Wide Web pages some pizzazz? Asymetrix Corp.'s \$100 **Asymetrix Web 3D** allows you to create 3-D effects for your home page with ease.

Based on the same concept as Asymetrix's 3D F/X, Web 3D helps you craft 3-D images, convert them to .GIF or JPEG images for distribution across the Internet, and then use an HTML editor to connect that image to a URL. Web 3D also features a catalog of 55 design elements so that you can jump-start your Web-page designs, drag and drop 3-D special effects (including surface, texture, color, and lighting effects), and create .GIF animations automatically. Import filters let you bring Autodesk 3D Studio models, .DXF CAD files, .WAV sound files, and image and video files into your 3-D Web pages. Real-time scene-preview capabilities let you see a solid-model preview of your rendered images.

The software supports integration with popular Internet browsers, including CompuServe Mosaic Direct, Netscape Navigator, and Web 3D Scene Viewer. To facilitate your Internet access, the package is bundled with such Internet connection services as CompuServe, Global Network Navigator, and IBM.

Asymetrix Corp., Bellevue, WA; 800-448-6543, 206-462-0501; <http://www.asymetrix.com>. *Circle 432 on reader service card*



In Your Eyes

LIGATURE SOFTWARE'S 32-bit **CharacterEyes Pro for Networks** is a network version of Ligature's optical character recognition software (a five-user pack is \$1,040). It uses advanced neural-network technology for capturing text at up to 300 characters per second. This version includes skewing at up to 20 degrees, batch processing, and detailed dictionaries.

Ligature Software Inc., Burlington, MA; 617-238-6734; fax, 617-272-3085. *Circle 418 on reader service card.*

Digital Video Player

YOU'VE TAKEN ALL THAT TIME TO DOWNLOAD A 30-SEC-ond video clip from the Internet only to find out that you can't view the clip on your current video player. Duplexx Software's \$15 **Net Toob** solves that problem by providing a universal full-motion video player that's capable of providing full-screen video with interleaved stereo sound and high-quality visuals. Net Toob uses a familiar VCR-like interface and supports all standard video file formats, including .AVI (for Video for Windows), .MOV (for QuickTime for Windows), and MPEG-1. MPEG files can be viewed at up to 30 frames per second. You can also download an evaluation copy from the company's World Wide Web site at <http://www.duplexx.com/>.

Duplexx Software Inc., Salem, MA; 800-321-7144, 508-745-7144; fax, 508-741-2543. *Circle 428 on reader service card.*

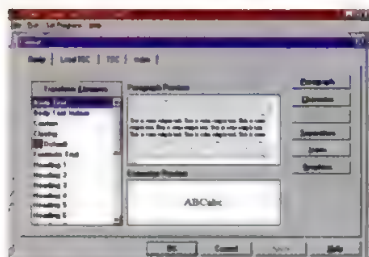
A Transit Lounge for HTML Files

ARE YOU TIRED OF MANU-ally inserting the HTML tags into your files? InfoAccess's \$495 **HTML Transit** is an HTML publishing tool that automates the process of con-

verting and formatting Microsoft Word, WordPerfect, Ami Pro, FrameMaker, Interleaf, and RTF documents for use on the World Wide Web. By using templates, HTML Transit lets you set the parameters for the appearance of your Web pages. You specify which characteristics of your word-

processor document to translate to HTML and how those characteristics will be interpreted; the software will even divide a large document into a series of smaller HTML files. HTML Transit supports the working draft of the HTML 3.0 specification, as well as the HTML extensions of Netscape Navigator and Microsoft's Internet Explorer.

InfoAccess Inc., Bellevue, WA; 800-344-9737, 206-747-3203; <http://www.infoaccess.com>. *Circle 431 on reader service card.*



PICK AND CHOOSE: HTML Transit lets you assign formats.

verting and formatting Microsoft Word, WordPerfect, Ami Pro, FrameMaker, Interleaf, and RTF documents for use on the World

Three Tiers of Pentiums

HEWLETT-PACKARD CO. IS OFFERING A 166-MHZ VERSION OF its **HP Vectra VL4**. The system, which is now available in both desktop and mini-tower cases, starts at \$2,337 for a desktop model with 8MB of RAM, a 1.2GB hard disk, a quad-speed CD-ROM, a 16-bit sound card, and 256K of burst-synchronous cache. A similarly configured mini-tower system, only with 16MB of RAM and a Matrox Millennium graphics card, costs \$3,108. The systems ship with Windows 95 preloaded.

Reaching for the high end of the marketplace is Zenith Data Systems Corp.'s mini-tower system, the **Z-Station GT**. Priced at \$4,041, the 166-MHz Z-Station GT comes configured with 16MB of RAM, 2MB of Video DRAM, 512K of synchronous pipelined-burst cache, a 2.1GB Mode 4 hard disk, a 64-bit Ati CT video graphics card, a quad-speed CD-ROM, a 16-bit Sound Blaster sound card, a microphone, and speakers; you can choose to have either Windows 95 or Windows 3.11 for Workgroups installed.

By contrast, AST Research's **Bravo MS-T 6150** mini-tower systems are optimized for use with Windows NT, which comes preloaded. The \$5,000 basic system comes equipped with a 150-MHz Pentium Pro processor, a 1.6GB EIDE hard disk, 16MB of RAM, a PCI-based 64-bit ATI graphics controller with 2MB of VRAM, a 16-bit Sound Blaster-compatible sound card, and a quad-speed CD-ROM. AST includes its VirusShield (which uses McAfee Associates' virus-detection technology) and security software, SystemGuard.

Hewlett-Packard Co., Palo Alto, CA; 800-752-0900; fax-back, 208-344-4809; <http://www.hp.com>. *Circle 424 on reader service card.*

Zenith Data Systems Corp., Buffalo Grove, IL; 800-533-0331, 847-808-5000; fax, 847-808-4434. *Circle 425 on reader service card.*

AST Research Inc., Irvine, CA; 800-876-4278, 714-727-4141; fax, 714-727-9355. *Circle 426 on reader service card.*



SPEED DEMON: Hewlett-Packard Co.'s 66-MHz Vectra VL4.

BRIEFS

Books

Unlock the power of Lotus Notes with **The Lotus Notes Idea Book**, which provides more than 50 examples of how the popular work-group program can solve problems and streamline work (\$24.95, Addison-Wesley, 800-447-2226) There's more to doing business on the Internet than just getting online. **The New Internet Business Book** shows you how to put your business online, find business resources available there, and establish an effective marketing plan (\$24.95, John Wiley & Sons, 800-225-5945)

"Mommy, what's a GUI?" **The Computer Dictionary for Kids... and their Parents** covers 700 common computer terms and is loaded with full-color illustrations (\$14.95, Barron's, 800-645-3476).

Hardware

MicroNet Technology's line of removable media-storage modules, **DataDock**, will now accommodate Iomega Corp.'s 1GB Jaz drive so that you can create a Jaz array by striping two Jaz modules together or use Jaz drives in conjunction with other DataDock drive mod-

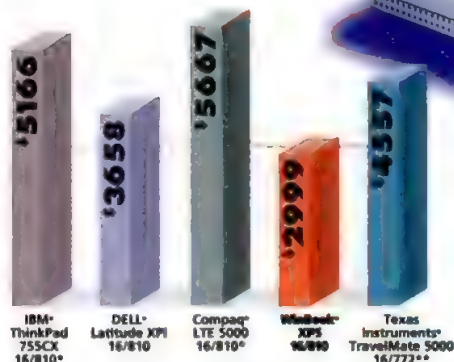
ules (714-453-6100) Orchestra Multi-Systems has added the **Tuba II**, a \$699 17-inch monitor, to its Brass series of monitors (800-237-9988) Ask LCD's \$6,295 **Impact 400** is a lightweight LCD panel with an active-matrix, Super VGA, 800-by-600 resolution display and the ability to handle full-motion video projection (800-275-5231).

Internet

Liberty Financial Companies' subsidiary, Independence Life and Annuity Co., is offering **WebSaver Annuity**, a guaranteed-return

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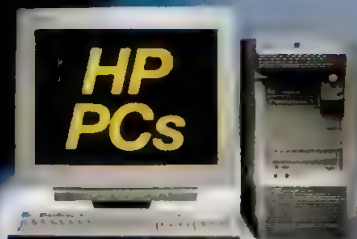


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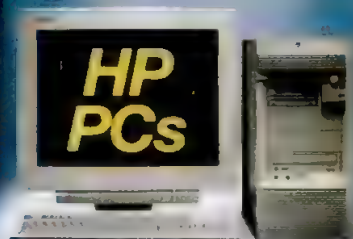


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Call 1-800-822-HP-PC, Ext. 1106,† for more information or the name of your nearest HP reseller. Or visit us at <http://www.hp.com/go/vectra>. For once, more *is* less.

Powerhouse Printing

EVER FEEL AS IF YOUR wish list for a laser printer exceeds the budget you've allotted? Texas Instruments' value-minded **micro-Laser WIN/4** closes that annoying gap. At just \$499, the WIN/4 features 600- by 600-dot-per-inch resolution and is rated at 4 pages per minute. The unit has a warm-up time of under 10 seconds coming from the standby mode (25 seconds from a cold start). The WIN/4 uses TI's Windows Printing System for integrating and optimizing your printing under Windows 3.1 and Windows 95. With its small footprint and streamlined look, this printer is ideal for homes and small offices; be forewarned, though, that there's no built-in networking functionality.

Texas Instruments Inc., Austin, TX; 800-848-3927; <http://www.ti.com>. Circle 420 on reader service card.



Instant Replay

CALL IT A CROSS BETWEEN A digital tape recorder and an audio-only personal organizer. Sycom Technologies' **Total Recall** is a compact voice recorder that exemplifies just how critical thoughtful design is to a product's execution. The 3.5-ounce pocket-size device is available in 11-, 23-, and 47-minute versions (priced at \$149.95, \$199.95, and \$299.95, respectively).



The easy-to-control buttons are placed conveniently on the unit. An LCD screen provides a clock that's equipped with reminder alarms as well as a means of navigating through a unique file-folder system for sorting and storing messages. You can use the unit's line-out jack to export sound files to your PC or tape recorder; a cable is not included.

Sycom Technologies Inc., Bala Cynwyd, PA; 610-660-5770; fax, 610-668-5404. Circle 419 on reader service card.

Parental Control

EVEN IF YOU'D LIKE TO THINK OF IT AS YOUR OWN, YOUR household computer is likely your family's computer. Alpha Software Corp.'s \$29.95 **KidSecure for Windows 95** is a useful package for parents who want to restrict their kids' access to specific files and areas on the computer while letting the kids get their daily dose of DOOM. Along similar lines is Providence Systems' \$49.95 **Parental Guidance**, a tool for helping parents manage and keep tabs on their children's computer usage and Internet access; you can also control the time spent with programs.

Alpha Software Corp., Burlington, MA; 800-451-1018, 617-229-2924; <http://www.alphasoftware.com>. Circle 421 on reader service card.

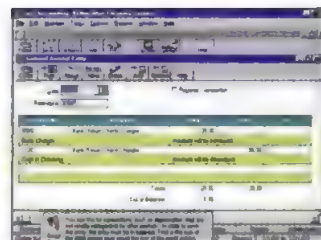
Providence Systems, Westlake Village, CA; 800-525-5763; fax, 818-865-0922. Circle 422 on reader service card.

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Peachtree First Accounting Release 2.0 is a \$49 application that provides the basic accounting services any small business needs, and it does so in a clear, intuitive manner. Components include a general ledger, accounts receivable, accounts payable, and ac-



STEP BY STEP: Peachtree First Accounting Release 2.0. count reconciliation; new to this version is the addition of payroll and inventory functions.

Best!Ware, Rockaway, NJ; 800-322-6962, 201-586-2200; fax, 201-586-8885. Circle 429 on reader service card.

Peachtree Software, Norcross, GA; 800-247-3224, 770-564-5700; fax, 770-564-5888. Circle 430 on reader service card.

BRIEFS

annuity that lets customers order a policy online while funding the policy with a check sent via regular mail (<http://www.websaver.com>) **Isys Web**, from Isys/Odyssey Development, brings Isys's search-and-retrieval software to the World Wide Web. The \$4,995 Web server recognizes and converts 40 different file formats and works with any HTML viewer (303-689-9998) **VocalTec's Internet Wave** is a tool for broadcasting quality audio communications across the Internet. You can download a free copy from <http://www.vocaltec.com>.

Software

IBM Corp.'s \$49 IBM AntiVirus Version 2.4 provides an update to this powerful anti-virus software; the package includes disks for OS/2, Windows 95, DOS, and Windows 3.1 (800-742-2493) **CoStar Corp.'s \$89 AddressMate Plus** provides address-correction functionality that adds the nine-digit ZIP code information to your Microsoft Word, WordPerfect, and Word Pro/Ami Pro databases; you can also use the software as a standalone product (203-661-9700) **World Software Corp.'s \$249.95 Wordbox 2.1 Docu-**

ment Management upgrades the workgroup document manager to include support for Windows 95, enhanced .0 compression, a file-level security option for networks, and a network mirror-and-restore feature (201-444-3228) To perfect that perfect marketing strategy, try Business Research Software's **Quick Insight**, a \$129.95 management package that will analyze your marketing strategy. Aimed at small businesses, Quick Insight looks at elements including the market environment, the industry, the competition, and customers' needs (512-251-7541).



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- Intel 75, 90 or 120 MHz Pentium processor
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from **\$4,975***

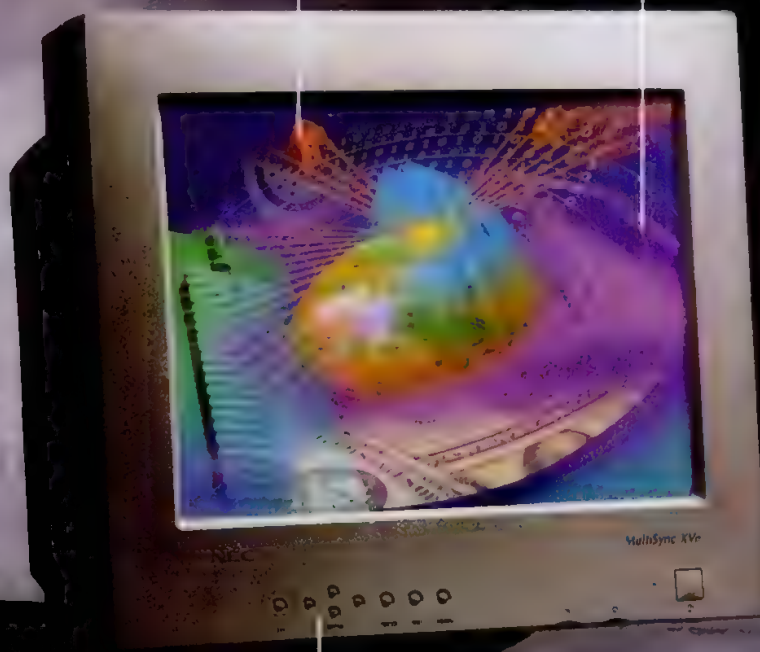
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When It's Finished

The hick and his wife come to New York, gawking in wonder at the tall buildings, astounded at the steady din of trucks and jackhammers, the omnipresent construction crews, buildings coming down, and buildings going up. Overwhelmed, he turns

to his wife and says, "Hey, Darlin'. Let's come back when it's finished."

I wish I could come back when it's finished, too. Not to New York, but to the software and hardware that I use every day. Flying in the face of all the conventional wisdom about maturing markets and the commoditization of computers, the current trend appears to be that nothing ever gets completed before it's replaced by a newer version.

I recently upgraded my Gateway 486/66 by replacing the ATI Mach 32 video card with a Number Nine Motion 771 with hardware MPEG support. The Mach 32 was the result of years of effort, research, and development on ATI's part. It was one of the watershed 32-bit video cards that ushered in the era of high-performance Super VGA cards. Although ATI revised the drivers a number of times, the Mach 32 card never really achieved the stability and full compatibility that would have made it a finished product in my book. Instead, ATI put its effort into the Mach 64. Will it be finished before the next available technology sweeps it aside?

Netscape Navigator is another case in point. Over 80 percent of the people who use ZD Net and *PC Magazine's* Web site use Netscape Navigator, giving it a market dominance that hardware vendors can't even dream about. Netscape has yet to finish a version of Navigator, including the retail version of 1.2. Web users take GPFs in stride. They tinker with Winsocks, dialers, and configurations until they find one that's reasonably stable. Then they download the latest version of Navigator and begin all over again.

Netscape can get away with this because it has consistently advanced the state of HTML with useful extensions, irrespective of international standards. Web page authors, wanting to offer more interaction, pizzazz, and power at their sites, use the new features and thoughtfully provide a button at the bottom of the page that invites you to download the latest version. In this environment, getting on to the next thing and having it make your last thing obsolete becomes a corporate necessity. If Netscape slows down or

adheres to HTML standards, its competitors can catch up and produce compatible browsers.

Netscape has done a lousy job on the tools side. Where are the tools for creating Web pages? Perhaps it's not their specialty or their field of competence. Why do we have to hand-code HTML to use Netscape's advanced features? Why are the vendors who specialize in authoring tools finding out about the new extensions at the same time as everyone else? Granted, the Web is young, but programming, standards, and toolsets aren't.

A few products actually do get finished: my Hewlett-Packard LaserJet 4, for example. Now that it's finished, though, it's obsolete. PCL 5 is complex, and HP's driver went through a number of revisions in the months after the LaserJet 4s started shipping. Now that all the unknowns are gone, it's unsupported, at least for free. I called tech support recently to inquire about a funny gray line, only to find out that I had to call a 900 number at \$2.50 per minute to get support. So it cost me ten bucks to find out that a new toner cartridge would probably cure it.

Even my trusty Gateway Liberty notebook dishes up an occasional surprise by locking up or crashing back to DOS while on battery power. Several BIOS revisions made the problem far better, but some subtle flaw still remains.

I save early and often, so it's not much of an inconvenience. Will it ever be finished, or will I be seduced away by some new Pentium subnotebook?

We're caught, perhaps permanently, in a delicate balance between great new ideas and the installed base. Our PCs are saddled with severe compromises in order to remain compatible with existing hardware and software. It would be great if we could start fresh, as with Netscape, by just clicking on a button somewhere, but you know it's not like that. Upgradable, modular PCs have never been a good strategy. For all these failings, however, PCs have utterly insinuated themselves into our work, our play, our lives. If they weren't productive, we wouldn't be blowing all this money on them. □



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Nothing ever seems to get completed before it's replaced.



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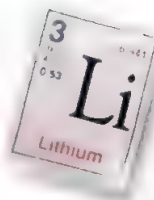
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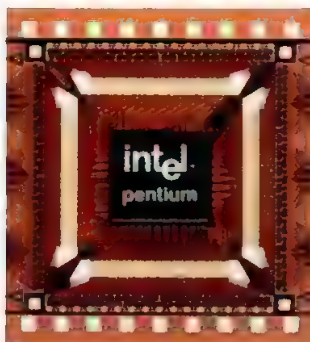
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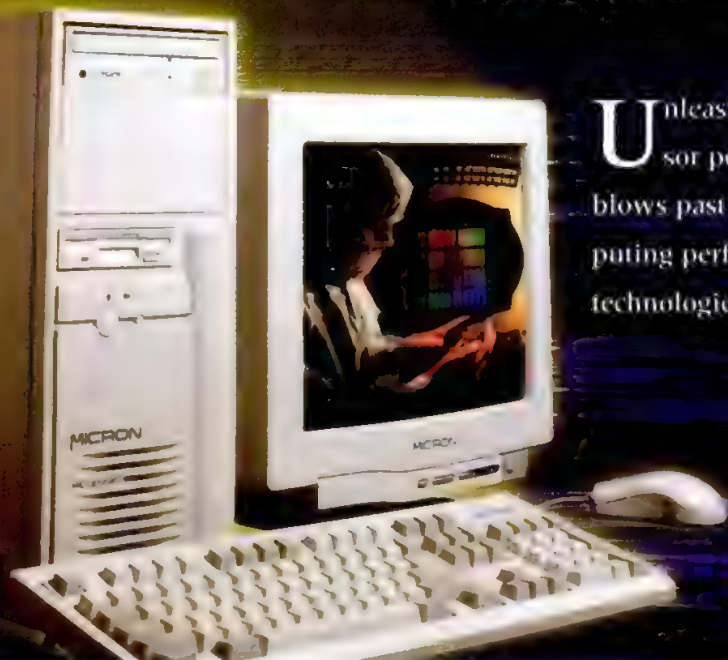
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January 9, 1996
MAGAZINE



December 1995
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C • 32MB EDO RAM • 2.1GB EIDE hard drive
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JOHN C. DVORAK

In the Wake of Windows 95

Anyone who follows the stock market witnessed the recent stock price collapse of a number of major software companies. Symantec, for example, was selling in the 30s last October before it tumbled to 10 or so because of a bad earnings report. The com-

pany was not alone. The culprit is Microsoft and its policy of preannouncing products.

The purpose of preannouncing is simple: to keep customers from straying off to competitors' products. The preannouncement will supposedly discourage people from buying from a competitor by making customers think your product will be better and therefore worth waiting for. In the case of Windows 95, Microsoft wanted to keep people from trying OS/2.

But the entire Windows 95 marketing scheme was botched—at least as far as the industry is concerned. First, it prompted customers to put all purchases on hold including those of Microsoft products. This phenomenon, whereby the customer will stop buying your product because you promise something better, is the main reason preannouncing is dangerous.

But what makes Windows 95 problematic is that it also represents a platform shift—an unwanted one, but one with no viable alternatives since Microsoft is in control and chooses not to allow any reasonable alternatives except the server-oriented Windows NT. Such shifts, if not done with finesse, confuse customers and hurt the industry.

What Microsoft should have done, if it cared about the health of the industry, was to bring out Windows 95 the way Apple introduced the Macintosh: as a next generation system. And it should have followed Apple's policy of maintaining the Apple II long enough so people could migrate

Windows 95-compatible programs. Since my Windows 95 system went into never-never land for reasons unknown, I've reverted to 3.1, thus postponing serious reviews of Windows 95-only products. I'm not alone. A lot of people have reverted. This is not good for the users, and it's horrible for the vendors.

Even years after the PC came out, way back in 1982, you could still buy CP/M machines (and still can). CP/M was updated, and the machines were improved. Eventually it gave way, but nobody forced anyone to switch. Also, when the IBM PC was released, people flocked to a solution called Baby Blue, a Z-80 card that let users run old applications. At least Windows 95 managed to accomplish this: It supports most (though not all) Windows 3.1 apps.

But then there is the interface issue. Some people prefer the Windows 3.1 interface. This is the real Windows interface, as I see it. If Microsoft can't bring itself to make one crummy update of Windows 3.1, then, as an option, it should keep the Windows 3.1 interface for Windows NT. People who prefer the old interface could keep it as long as they wanted. Windows NT could also employ the Windows 95 interface or the OS/2 interface as options.

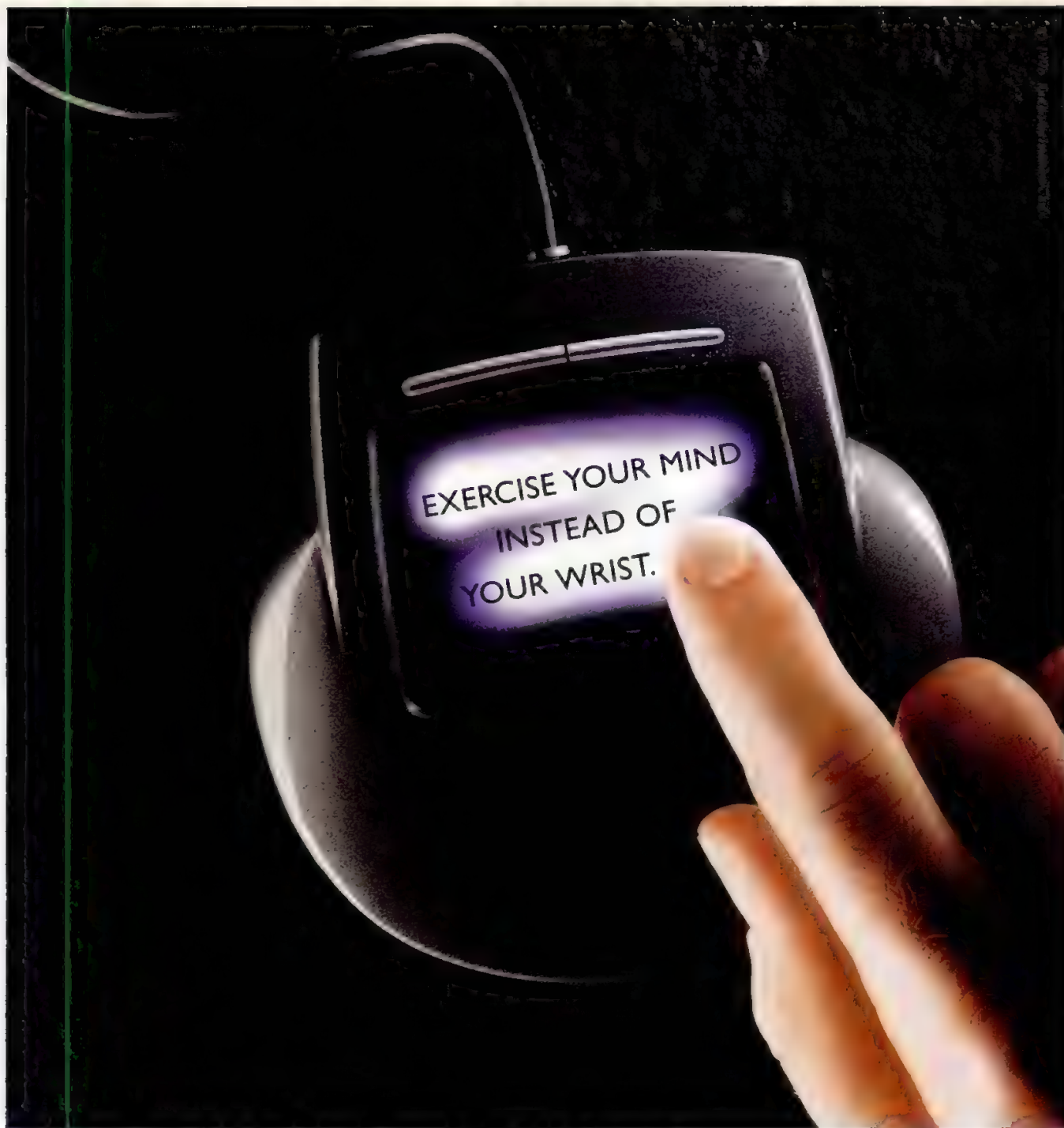
Anyway, it's possible that I'm missing the point. It's quite likely that Microsoft's goal with Windows 95 was to sink a few stocks and perhaps sink the rest of the industry as part of its own growth strategy.

Free games, add-ins, and utilities will destroy a lot of com-



SLASH-AND-BURN

What Microsoft has created is an uncomfortable, forced platform shift for no good reason.



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Inside Track

Look for **Pentium processors to break 200 MHz** by springtime. The Pentium and the dual Pentium machines will **continue to be mainstream**; meanwhile the Pentium Pro remains on the sideline because it doesn't run 16-bit software as fast as a Pentium running at the same clock speed. Besides, it will be the generation **after the Pentium Pro** in which drastic changes in design create real performance breakthroughs. Let's start guessing what the name will be now. My guess: **Pentium Pro Gold**.

In an Ideal World Dept.: I'm one of those who believed that **the future of backup and archiving** might be the **writeable CD-ROM**. Having played with these units, I'm no longer so optimistic. Writeable CD-ROM technology at the moment is for professionals who need to make beta copies of programs that will eventually be pressed en masse. To use a CD-ROM writer as a backup unit is **a royal pain in the butt**.

The **problem with the writeable CD technology** is that you have to make an "image" to be written to the disk. This can be either a virtual image or an actual bit-for-bit image. If you want to back up 650MB, you want to have another 650MB on your hard disk empty to store the image, which is then transferred to the CD-R. (Using a virtual image reduces this requirement.) You get **one shot at writing to the disk** from beginning to end. You can do multiple sessions, but that's **a real hassle, too**. The point is that once the CD-ROM starts to "burn" you can't stop it. If there is a glitch, brownout, operating-system hiccup, horribly fragmented file, or any number of things, then the CD doesn't get burned, and you end up with **a blown session**. These are common, and **the result is a totally useless disk** that must be discarded. It takes a couple of hours to prepare your files to be burned into the disk. If something changes, you have to start over. And if your hard disk isn't fast enough, you can't even burn the disk at all.

One vendor told me that the quad-speed CD-ROM writers **were kept off the market** because the system requirements were **outrageous**, and tolerance for error was nil. I recommend people buy a cheap optical drive and use it for backup and archiving—at least until a new technology arrives called **packet writing**.

Packet writing is now being standardized, and it will allow a CD-R to act a little more like a normal optical drive insofar as using it for backup is concerned. I'm told that many of the CD-R units on the market **will be upgradeable** to packet writing technology with a BIOS revision. Make sure to check before you buy a CD-R. Until packet

*This disk, DVD,
will replace CD-ROM
faster than you can
say "Jazz Jackrabbit."
There will be a
writeable version and
even a rewriteable
version with slightly
different capacities.*

writing comes along, these devices are **close to being useless for the average user**. On the other hand, it's kind of a thrill when you actually make a disk that works.

CD-R Alternative Dept.: Then again, this technology is going to be leapfrogged soon by **DVD**. The last time you read about this, it was called the **SD Disk**, although it was originally named the Digital Video Disk. It was DVD last year, then changed to SD Disk at Comdex, and now is back to DVD at CES. This time, though, the V doesn't necessarily stand for "video"—they don't know what it stands for, and it may be referred to as the DV Disk. **I've been telling people it's short for DVorak** just to get their reaction. Also, the terms **DV-ROM** and

DVD-ROM are floating around. Anyway, this disk will replace CD-ROM faster than you can say "Jazz Jackrabbit." There will be a **writeable version and even a rewriteable version** with slightly different capacities but with cross-compatibility.

Specifications of the DV Disk: Here are the basics (cut this out and save it to resolve bets): It can be one- or two-sided, each side containing one or two layers. Each side can contain 4.7GB; a double-density, single-sided disk will hold 8.5GB. The maximum capacity for a double-density, double-sided disk would therefore be 17GB. The capacity decreases for write-once technology to 3.8GB per side, and the overwrite (write-many) capacity is 2.6GB per side. The pit, which holds the data, is 0.4 microns across. One side of a small disk will easily hold one full-length movie. The specification allows room for 8 dubbed language tracks and 32 subtitle language tracks. Full-screen, letterbox, and wide-screen viewing of the movie is selectable. The movie audio will be the so-called 5.1 surround (five discreet audio channels plus bass). Audio disks will be sampled at 96 KHz providing full, 24-bit sound. Backward compatibility with old CDs and, presumably, old CD-ROMs will be accomplished by using two different lens apertures in the pickups. MPEG-II decoding is part of this system.

The first units—players only—will be out at the end of the summer. After that, **it will be a mad rush**. I suspect that while the big companies will target computer users, as well as the AV-starved public, the prices will not be equal. I reckon the DV-ROM systems will be pricey, probably over \$1,000 at first. Unless the writeable mechanism is included, **I'd pass on the first few iterations** of these things. Hopefully, by the summer of 1997, these units will cost around \$500 and allow read-write 2.6GB operation. This device is **the floppy disk drive of the 21st century**. It will eventually cost \$75 for a drive—maybe less. □



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Kids and Computers: A New Paradigm

Kids and computers are a natural: Anyone who's spent five minutes in front of a PC with a youngster knows that. And the fun's hardly one-sided: We not only get the pleasure of working with the game or program but also of watching our young friends

talk to the PC, touch the screen, dissolve into giggles. But I'm convinced that almost two decades after Apples and TRS-80s arrived in our homes, we still don't get it right when we sit down at a computer with kids.

I began working with kids and computers back in the days when Seymour Papert's LOGO language had us all doing "turtle geometry." I've spent thousands of hours sitting at computers with kids, watching what interests them and what doesn't, how they respond, and when they turn off. Good software keeps kids involved through complex interactivity—from little kids' titles, like 3-D Body Adventure and Humongous's Buzzy series, on through Oregon Trail for junior- and senior-high-schoolers. Not just feeble look-and-click-level interaction, of which all but the youngest kids tire quickly, but that kind of interaction which also demands some thought before responding.

Even so, most kids tire of playing at the computer soon enough and return to other, more conventional activities—DOOM and other shoot-'em-up addicts excepted; more on kids and PC bang-bang in a future column.

A couple of years ago, curious about just what triggers this often-abrupt timeout in kids' attention spans, I began trying alternative physical setups. One of my experiments involved replacing a conventional desktop PC setup with one that instead put the image on a large-screen TV several feet from a comfortable sofa. There was no computer monitor per se, just a keyboard with an integral trackball, the PC tucked out of sight. The video signal traveled from the PC through a scan-converter and then an S-Video cable to the 32-inch TV.

I was floored by the difference—not only in the attention span of the kids (and the adults, too), but in the nature of their interaction with the PC and one another. Sitting back on a sofa, keyboard in one of their laps, kids and adults alike were more playful, more relaxed, more engaged. The big picture was more impressive and involving, and the TV controls allowed me to set up an even more colorful display. Unlike the previous setups, where

adults sat at a computer desk with little kids in their laps or next to older kids in chairs wedged against the desk, these adult-child duos and trios sprawled, slumped, sat on the floor with their backs against the sofa, chatted with others passing through the room, and slipped away for bathroom breaks but quickly returned. In other words, they behaved exactly as they did when they...watched television programs.

Aha: The more we make using a PC at home like another familiar, favorite home activity, the more people see using that PC as part of the continuum of their lives, and less as an exception.

I'm an amateur at this. I have no credentials as a behaviorist, did not rigorously define variables so as to test for each separately, and have used a random enough but hardly scientifically chosen sample. I claim no scientific validity for my observations. But I can tell you that they've been amazingly consistent. I've been lending friends scan-converters for a year and a half now to try this idea with their own families—and virtually all soon bought their own. Some even bought second home PCs and larger TV sets.

This is hardly a perfect setup. The cables from the keyboard and mouse are a tangly mess. The PC speakers must be next to the TV. All scan converters cut off the edges of the display, and cheap ones produce lousy images.

But what a difference this makes in

kid use, and parent-and-kid use, of a home PC!

Now, the clumsiness in this kind of setup is about to go away. The "hit of the suites" at January's Winter Consumer Electronics Show—as at Comdex, the most interesting stuff is now almost always shown only in suites in the hotels around the official convention venues—was Gateway's new home PC. It didn't have a name yet, but it absolutely knocked out those who saw it, including me.

Gateway ties a 32-inch big-screen TV, with its internal electronics upgraded to the level of those in a good computer monitor, to a conventional home PC, circa 1996 (100-MHz or better Pentium, 1GB hard disk, 16MB of RAM,



FAMILY PC HOUR

After almost 20 years, we still don't get it right when we sit down at a computer with kids.

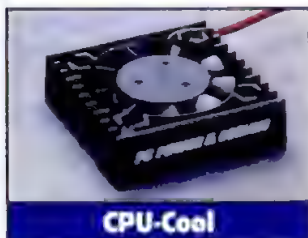
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CIRCLE 080 ON READER SERVICE CARD

JIM SEYMOUR

and so on). A wireless keyboard with an integral trackpad controls the system, as does a separate, hand-held device about the size of a TV remote control. A trackball and buttons on that remote allow you to control nearly every aspect of the system that doesn't need alphanumeric input. The keyboard and hand-held remote use radio-frequency signals, not infrared, so there are no worries about line-of-sight problems.

As a computer monitor, that big screen is beautiful. Gateway runs it at 640 by 480, which my experience with scan converters and big-screen TVs has taught me is right: Intellectually, you want higher res, but in practice, you can't read the small type from across the room. And you're far enough from the screen that you don't see jaggies. The Gateway system also works as a conventional TV set, with a great picture, fine sound (through the computer; buy the best-quality speakers Gateway offers), plus nifty controls and an on-screen program-information service from Hughes.

To use this system for an hour, as I did, is to understand that the home PC has been re-defined. Or at least—and this is a critical difference—the *family* PC. It's wonderful for anything you do on a computer with someone else: games, educational programs, homework, writing family letters, and so forth. You'll sit with your kids, help with their homework, discuss a paragraph in a book report with others in the room, or consult on game strategy. This system *encourages* that kind of interaction between two or more viewers, players, or workers. Computing needn't be solitary nor merely dyadic, and this system proves it.

And for grown-up work at home? It may be okay for Dad to check his e-mail on the machine while the rest of the family half-watches—though he'd better be prepared for some snide comments. It's probably *not* okay for Mom to dial into her office LAN, download a spreadsheet, and massage the numbers for the Tampa project for an hour or two: She'll send people fleeing from what is, after all, a de facto family room. So the new Gateway probably works better as a second home PC for families with adults who have a take-home computer.

I haven't yet worked with the release version of the Gateway system, which will be announced around the time you read this. I'll get back to you with a report after my family has lived with one for a few months. But I think I know what we're going to find: that Gateway got this one just right. □



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Home, Sweet PC

There's no doubt about it: PCs and consumer electronics are converging. It has been talked about for years. Now, it's finally happening with some promising results. Granted, it's highly unlikely that your next computer will be a set-top box with TV.

But it won't be long now. Here are some examples culled from the recent Consumer Electronics Show (CES) in Las Vegas.

1. Gateway 2000 showed a near-final prototype of its PC TV, a standard multimedia Pentium PC with a TV tuner tucked inside, driving a 31-inch Mitsubishi VGA monitor and controlled by a wireless keyboard (radio frequency, not infrared) and a handheld remote. Estimated price is \$3,800 for a Pentium/120 system with 16MB of RAM and the monitor. This is going to be a success—even more so if Gateway can drive the price down to \$2,999. One big caveat: I can't give you an impression of how good the TV image is because the final TV chip set was still being locked in. But the lower-res monitor was better than I had expected, even from 10 feet away.

Gateway's PC TV makes sense for a lot of reasons. Families may want to share a single PC with a large screen or use the PC TV as one of two household computers. Parents may feel uncomfortable allowing older children and their friends to use the PC in the den/home office where financial records are kept. With two systems, families could keep the second computer, most likely the PC TV, in a neutral site such as the television room. The PC TV will also sell well in the business market as an inexpensive conference room PC.

2. DVD was everywhere. Formerly known as digital video disk, high-density CD (HDCD), or super disk (SD), the format was renamed digital versatile disk (*gag*)—or DVD—for political reasons. DVD is the high-density, CD-size format we've been waiting for. For PC users, it's a 4.7GB to 8.5GB high-density CD that also plays existing CDs at 8X to 10X speed. For audiophiles, one DVD disk can hold all nine Beethoven symphonies, and it plays existing audio CDs. And it can hold at least two hours of ultra-high quality video plus soundtracks in 8 languages and subtitles in 32 languages. It also has the ability to switch among G, PG, PG-13, R, and NC-17 versions of the same movie. The video players will be here as early as sum-

mer at prices as low as \$500. PC drives will follow by fall.

I suspect DVD will catch on first and fastest as a video player because a lot of movie titles will be available immediately. On the PC side, it's going to take years before vendors stop shipping apps on standard-density 660MB CDs. But there will be some gains right away. The U.S. phone directories that require six standard CDs and a changer for best performance will fit on single high-density disks. Encyclopedias, and graphics and clip-art suites all cry out for high-density disks.

3. AMP, Compaq, and Intellon jointly demonstrated CEBus (Consumer Electronics bus), the decade-old standard wannabe that could control your lights, furnace, sprinkler, burglar alarm, and even motorized drapes over household current lines. Based on Intellon's spread spectrum signaling, this implementation of CEBus should be more reliable than existing X10 technology. The first iteration would use a standalone AMP-built controller box that could cost \$5,000, but ultimately it will use a far cheaper board inside your PC.

4. Sony showed VisionTouch, a \$249 program that will let you control a 100-disk CD changer from your PC. By using a CD-ROM loaded with the names of thousands of audio CDs, playlists, times, music types, and even album covers, your PC can recognize audio disks (each has a unique ID) and control the changer. For example, you could teach your changer to play 90 minutes of jazz followed by two hours of "dinner music." The same technology could

also control your TV and VCR, perhaps even using the PC's clock to eliminate the dreaded blinking "12:00" on your VCR's display.

Ironically, as the computer/consumer movements begin to coalesce, there are doubts about the future of CES. One of the major reasons is that vendors now prefer to exhibit their products at shows scheduled closer to the holiday buying season. Many mainstream vendors say they're planning to shift their resources toward E3 (Electronic Entertainment Exposition), a newer show held in Los Angeles in May. □



GATEWAY'S PC TV

This makes sense for a lot of reasons. Families may want one PC with a large screen or two computers.



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CIRCLE 076 ON READER SERVICE CARD

NETWORK EDITION

CLIENT/SERVER COMPUTING

Client/Server Unraveled

What does client/server computing mean in terms of products? Are there drawbacks? (Yes.) Here we demystify this market.



By David S. Linthicum

There's a race underway. A race that affects us all as every innovative organization speeds away from the centralized but simplistic world of the Big Blue mainframe toward the open but complex environment of client/server computing. The prize is a system that claims to be smaller, cheaper, faster, sexier, and more productive. Some of these claims are true; some aren't.

ILLUSTRATION BY ROBERT PASTRANA

INSIDE



If ever a computing term has been thrown about recklessly, it's *client/server*. People use this catch-all phrase to invoke any of a dozen specific concepts—and dozens more shapeless ideas to which they can put no other name.

RATHER THAN TRYING TO explain how the term is misused, we thought we'd stop and give you our take on this important area. Then, as we continue our coverage of client/server products, you'll have a good frame of reference. Most important, because we deal in labs-based testing of shipping products, we want you to understand how we see client/server computing in terms of products you can buy to help your business.

WE ASKED CONSULTANT and writer David Linthicum to walk us through client/server computing—what it means and what it doesn't mean. He has worked out in the field of client/server computing for several years, and offers a straightforward breakdown. He debunks some myths and points to some new client/server strongholds—the world of objects for one, the Web for another.

TURNING TO FIRST LOOKS, senior networking editor Frank Derfler reviews two products from Connectware that can help make small businesses seem bigger. Phoneworks is a call-handling and voice-mail system that can lend polish to your company's communications. (Page NE30.) Cruiser is a small-office groupware package that delivers core communications functions without some of the headaches of bigger packages. (Page NE29.) Both products are good bets.

FINALLY, IN MULTIPLE ACCESS, Rob Lipschutz, our technical director/networking, ponders the race between cable and telephone companies for control of two-way data into your home.

—Gail Shaffer

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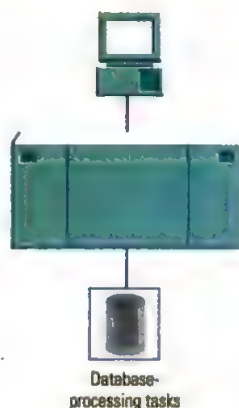
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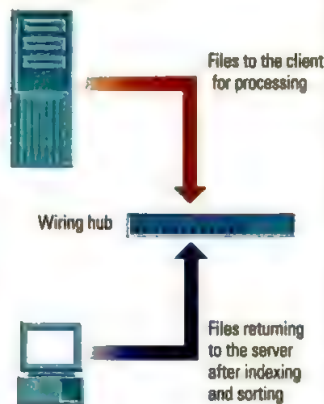
Mainframe database processing

With mainframe systems, the client enters data into a form sent from the mainframe, and all database processing happens on the mainframe. This system is easy on the communications links, but centralized processing requires a large up-front investment in equipment and staff. In addition, the architecture is largely proprietary.



Early LAN-based database systems

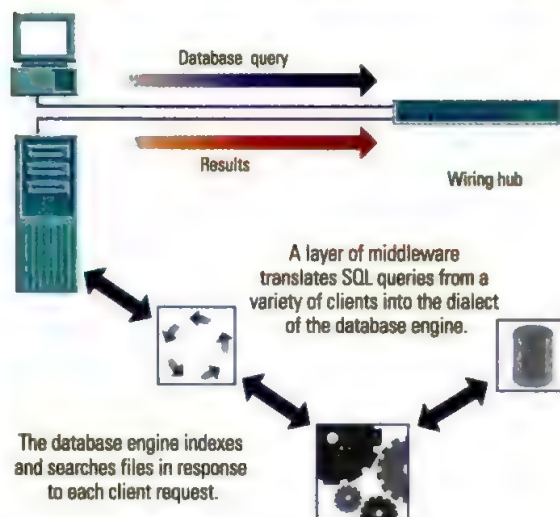
In early LAN-based database systems, the client requests files from the server and handles all processing. This architecture places a heavy load on the communications links and ties up client computers. While it is easy and economical to implement a small system, this approach doesn't scale up well. There are restrictions on the variety of the client computers and operating systems.



Client/server systems

In a client/server system, the client sends a query to the server. The file-handling processing takes place on the server. Thus, there is a light load on the network communications system. A layer of translating software called *middleware* allows the use of

many different operating systems and computer types. The single server shown here could represent a mix of PC architecture, Unix, mainframe, and other systems. This architecture works for small or huge installations, and it gives old mainframe applications new life.



Client/server offers the ultimate freedom of mixing and matching components at the client, the server, and all points in between. But we must pay for that freedom with added complexity. Just as a pit crew must know how to assemble each part of a race car's engine to service it properly, you need to understand the basic concepts and products of client/server computing to put it to correct use in your organization.

THE ALLURE OF CLIENT/SERVER

The driving force behind client/server computing is the fundamental belief that inexpensive PCs attached to inexpensive servers offer the ultimate in price and performance. For the most part, this is true.

Using many smaller systems, client/server developers can emulate the processing power of the PC's much larger cousins by distributing an application to various microcomputers and servers. Each takes on its own portion of the processing load, sharing information with other processors over a network. The idea is to increase processing capacity by distributing it.

Speed is an essential selling point of client/server development. Rapid application development (RAD) tools such as Borland's Delphi, PowerSoft's PowerBuilder,

and Microsoft's Visual Basic allow developers to toss together client/server applications in record time. Database server technology is becoming easier to use as well, and it is joined at the hip with RAD. Thus, this speedy and almost foolproof development platform promises to reduce the time it takes to bring applications to the user.

The allure of the GUI is another factor that drives hordes toward client/server. Client/server applications leverage the ease-of-use and consistency that users seek when they use GUIs such as Windows 3.1, Windows 95, Windows NT, and OS/2 Warp. Users are more comfortable and productive with applications that look alike and work alongside other productivity applications such as word processors, Internet browsers, and spreadsheets.

Finally, client/server is an empowering technology. Users are more self-sufficient when they use it. Applications and data exist on smaller, more accessible systems, not inside the belly of minicomputers and intimidating mainframes.

CLIENT/SERVER 101

The term *client/server* is so overused that it leaves both developers and users in a state of hype-driven confusion. Client/server,

simply put, is a computing model, one that's been with us for some time.

Client/server in its most simplistic form allows us to split the processing load between two distinct processes: the client and the server. Although both client and server can exist on the same computer, most client/server systems run the client process on one computer and the server process on another, using a network connection to exchange information. This model allows one process to operate independently of the other, perform specialized tasks, and share the processing load.

Typically, the *client* is a desktop PC running front-end software. *Front-end software* is any application or package that can send requests over the network to a server and process the returning information. The *server*, in turn, receives the requests and takes action on behalf of the client.

A PC running Windows 95 and a Delphi client/server application, for example, can submit a request to a database server (Oracle7, Release 7.2, running on a Windows NT server, for instance). The client usually sends database requests in the form of structured query language (SQL) statements using a dialect that the database server can understand.

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GLOSSARY

Client/Server Terms Demystified

By David S. Linthicum

Application partitioning The process of breaking a client/server application into portions that will run on the client, the server, and sometimes an application server.

Application-partitioning tools Application development program features that allow developers to distribute portions of a client/server application dynamically to several application servers. As a client/server system exceeds capacity, developers can add servers and run applications on them.

Client/server A computing model in which the application-processing load is distributed between a client and a server computer, which share information over a network. Typically, the client is a PC running front-end software that knows how to communicate with the server (usually a database server). The client/server model improves performance, because the client and server share the processing load.

CORBA Common Object Request Broker Architecture; an object standard, from the Object Management Group (OMG), which defines interfaces between networked objects that allow them to work together. Object request brokers (ORBs) based on CORBA provide a new form of middleware for client/server development.

Database server A system that receives requests from client applications over a network and responds by returning requested data (the answer set). Each database server is made up of a computer, an operating system, and database server software.

Distributed Computing Environment (DCE) A group of platform-independent middleware services, from the Open Software Foundation, that allow distributed applications to work together. DCE contains distributed files services, naming services, a time service, thread services, remote-procedure-call services, and security services.

4GL Fourth-generation language; a high-level language usually built using a 3GL. 4GLs, which are easier to use than 3GLs, are generally preferable for creating database applications and for use with popular development tools.

Integrated Database Application Programming Interface (IDAPI) Similar to ODBC, IDAPI provides multiple database access middleware. A product of Borland, IBM, and

Novell, IDAPI is the database middleware of choice for the development tool Delphi. But IDAPI is less popular than ODBC.

Message-oriented middleware (MOM) Middleware that uses messages and queues to exchange information. Unlike RPCs, MOM allows applications to continue processing before a remote-service call is complete. Moreover, MOM is better suited for slower networks such as WANs and the Internet. Currently, the Message-Oriented Middleware Association (MOMA) is working with several vendors to establish standards for the MOM industry.

Middleware Software that sits between the client and the server to facilitate communications. Middleware provides developers with easy-to-use APIs for remote server access. Middleware releases developers from the complexities of the GUI, operating system, network, and database server. DCE, IDAPI, MOM, ODBC, and RPCs are examples of middleware.

N-tier model A client/server system that uses application-partitioning tools or distributed objects to distribute the processing load among as many application servers as are required to support the processing load. N-tier can support many more clients than the two-tier model.

Open Database Connectivity (ODBC) A component of the Windows Open Services Architecture (WOSA) that provides multidatabase access by adding its own API layer on top of the native database layer, thus simplifying access. The developer need deal with only a single API to access numerous database servers, because ODBC can translate standard ODBC function calls into many different native database dialects.

Object Linking and Embedding (OLE) A standard method, defined by Microsoft, for exchanging information between Windows applications. Host applications (known as *containers*) are linked to OLE objects when they contain references to those objects. An embedded object, by contrast, contains an actual copy of the object.

OLE automation A process that allows a Windows application (known as the *OLE automation server*) to make its services available to other Windows applications (known as the *OLE automation clients* or *controllers*) using a common interface. The two types of OLE automation servers are *in-process* and *out-of-process*. An in-process OLE automation server runs in the same

memory space as the client application, usually as a DLL. An out-of-process OLE automation server runs in a separate memory space, and sometimes on another computer connected by a network.

Relational database management system (RDBMS) A database application back end that stores information in two-dimensional tables linked by common properties. SQL is used to create, manipulate, and extract data from relational databases.

Remote procedure call (RPC) A command that allows developers to invoke procedures on remote servers using local procedure calls. RPCs halt application processing until the function returns.

Structured Query Language (SQL) A relational data-access language created by IBM. Most database server engines use SQL as a standard way of accessing data from client applications.

Three-tier model A client/server system that places a middle tier (a computer) between the client computer and the server computer of the *two-tier model*. The middle tier, usually running a transaction processing (TP) monitor or object request broker, provides another location for application processing. Developers can support many more clients with a three-tier model than a two-tier model.

3GL Third-generation language; a language such as C, COBOL, FORTRAN, or Pascal that provides developers with considerable flexibility at the cost of ease of use. Most 3GLs can handle such detailed tasks as direct memory manipulation and physical disk access, which most 4GLs cannot handle. 3GLs, however, are complex and require more development time for applications.

Two-tier model A client/server system that has a client and a server computer. The client requests data from the server; the server provides the data. Most client/server systems are built using this model, but two-tier systems support a limited number of clients.

Visual Basic Control (VBX) A chunk of executable code that conforms to Microsoft Visual Basic's interface standard. These snap-in application components bring additional functionality to an application. Although Visual Basic was the first to use VBXs, other development tools use them as well. OCXs, or OLE Custom Controls, are destined to replace VBXs soon.

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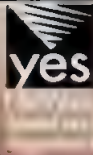
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Consider the Component Object Model

By David S. Linthicum

The idea is simple. Rather than build applications from scratch, developers assemble them from pre-built components. But no widely accepted standard exists for building application components.

So what's a developer to do? One might find solace in Microsoft's OLE-based Component Object Model (COM), which is really the Object Request Broker (ORB) for OLE. COM defines the interfaces between OLE component objects within applications. COM competes directly against the Object Management Group's (OMG's) Common Object Request Broker Architectures (CORBA) and its component incarnation, OpenDoc.

COM is still considered bleeding-edge technology. Even so, the number of development tools that support COM grows monthly. Not surprising, most of them are from Microsoft and include Visual Basic and Visual C++. COM is the clear direction for many applications and development environments looking to leverage the benefits of component-based development. As software becomes more complex and specialized, component-based development may be the only way to manage this complexity without breaking the bank.

Unlike CORBA, though, COM's object model does not

support *multiple inheritance*, which would allow detailed customization of components. COM can, however, support multiple interfaces and provides for reuse of components under an aggregation mechanism. Aggregation means that a component can encapsulate the services of other components, thereby changing the characteristics of a component.

Although COM is a single-machine ORB, Microsoft is now moving to distribute OLE objects over a network through its distributed OLE. This will allow OLE components to reach out and touch other network-accessible OLE components as if they existed locally. The new Visual Basic 4.0, for example, supports an early version of distributed OLE. COM provides the interprocess communications (IPC) through an RPC.

To use COM for component-based development, developers must first obtain a development environment or app that adheres to the COM/OLE standard. After that, it's a matter of purchasing the components required for an app from third-party component vendors, and building those components that are not available (if any). Then you plug them all together.

As demand rises for COM components, everything from communications software to Web browsers will be available as components.

Middleware provides a common interface for the front-end software and server, allowing it to traverse GUI, OS, network, and native database driver layers using common calls. To conclude the operation, the database server processes the request and returns the requested data to the client for processing by the client application.

BUILDING BLOCKS

There are three basic software components of client/server: front-end software, middleware, and server software. Front-end software includes applications development tools and reporting tools, including spreadsheets and word processors. Front-end software allows users to connect to servers, submit requests, and receive information.

Microsoft Excel for Windows 95, for example, uses its built-in ODBC interface to link to most major database servers and funnel data into a waiting spreadsheet for local processing by a user.

Reporting tools also link to database servers, allowing users to create ad-hoc reports and graphs, as well as run canned reports for applications such as invoicing and sales reporting. For decision-makers, client/server means easy access to corporate information via an arsenal of new decision support system (DSS) tools, many centered around a new type of DSS technology called online analytical processing (OLAP).

Front-end development tools, such as

Delphi, PowerBuilder, and Visual Basic, now dominate the market and provide expedient client/server applications development. All these tools offer RAD, which enables developers to build applications from prebuilt component parts.

The utilization of the object-oriented development model and the ability to use third-party snap-in custom controls (for example, OCX and VBX) let developers make the most of existing code and components. These tools also provide built-in connections to most database servers and the ability to distribute runtime versions of applications to the masses for fun and profit.

Middleware, in basic terms, is the portion of the client/server system that connects the front-end software with the server; it's the "/" in "client/server." Its benefit is in its ability to move the front end and the server away from the complexities of the operating system, network, and native server calls.

Many flavors of middleware are available; it is not simply one kind of product. These include middleware built specifically for databases, middleware that uses messaging exclusively, middleware that uses remote procedure calls, middleware that uses object request brokers, and middleware that performs transaction processing.

MOVING YOU TO TIERS

Client/server computing recently moved from being a complex environment to

being a highly complex environment. Why? Because of the acceleration in the trend of using multiple tiers in the construction of client/server systems.

Traditional client/server development uses only two tiers: the client and the server. In a two-tier system, developers place most application logic on the client, using the server for data services only. This type of configuration is also known as the fat client/thin server model.

Although two-tier client/server applications are easy to conceive, build, and maintain, the two-tier client/server model cannot scale to the enterprise. This means that two-tier architecture cannot support the thousands of users who use enterprise-wide applications, now the domain of mainframes.

To support such a large processing load, client/server developers learned to employ three-tier or multitier client/server architectures. This means that a client/server application is distributed to additional processors, or tiers, which provide additional processing power.

Developers can create multitier client/server applications using TP monitors, application-partitioning tools, or distributed objects. Although multitier client/server does provide additional capacity, developers pay for the added power with even more complexity, more development time, and more integration nightmares.

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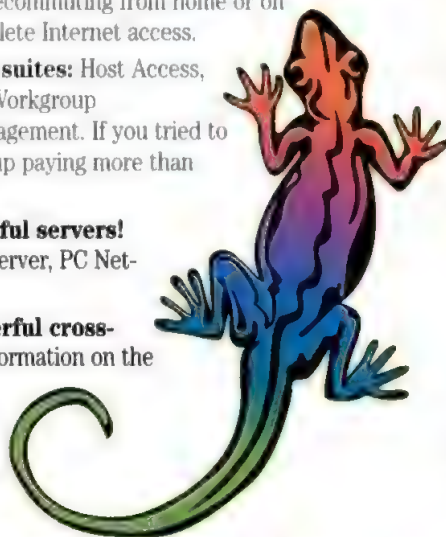
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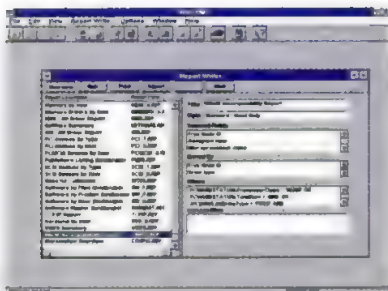
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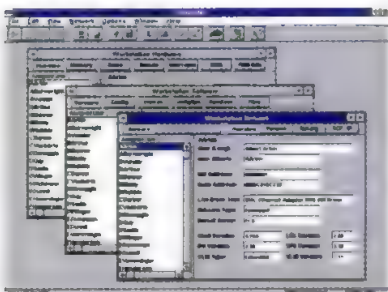
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er is a maze of tools, technology, and computing models. But how should you approach client/server? Well, its like eating an elephant: You do it one bite at a time. And you'll likely need consulting help.

Let's move further into the realm of client/server computing by looking closer at five major product areas: database servers, applications development tools, reporting tools, OLAP tools, and middleware. We'll also look at how products in each area work with one another to fulfill the promise of client/server computing.

Database Servers

ALL SECTIONS BY DAVID S. LINTHICUM

At the heart of most client/server systems, database servers provide secure access to shared data for client applications that request database services. Clients send requests over the network to the server, usually as an SQL statement. The server interprets the request and sends the appropriate data back to the client.

Relational and nonrelational database servers come in every size and shape. Most database server software—such as Oracle7 or Sybase System 11—runs on dedicated machines. And database servers run over a variety of processors and OSs. Thus client/server architects have a choice in meeting the requirements of an application. Oracle, for example, runs on most RISC- and CISC-based Unix systems, including Hewlett-Packard HP/UX and Sun Solaris. Oracle also runs on Intel-based servers that run SCO Unix and Novell's NetWare.

A few database server vendors, such as Borland (Interbase) and Sybase (SQL Server), provide versions of their database servers that run on the client (as, for example, a Microsoft Windows 3.1 or Windows 95 process). This enables client/server developers to build client applications without having to invest in a dedicated database server right away.

Relational database servers (also known as SQL servers or SQL engines)

make up most database servers in use today. Object-oriented and multidimensional database servers, however, are catching up in a few niche markets.

Object-oriented database servers, such as GemStone from GemStone Systems, store information in the form of objects. They provide a better fit with client-side development tools that support the pure object model.

Moreover, object-oriented databases provide a better home for complex data structures than their relational cousins. Multidimensional database servers, such as Essbase Analysis Server from Arbor Software Corp., provide a view of the data that is more natural for end users; they also support the new online analytical processing (OLAP) tools.

SERVER FUNCTIONS

Database servers don't just serve up data; they provide locking mechanisms and multi-user access controls that protect data from the dangers of concurrent access. The data-

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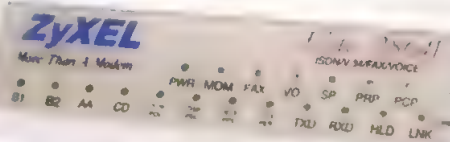
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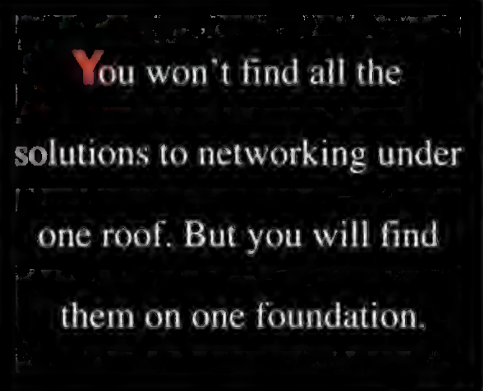
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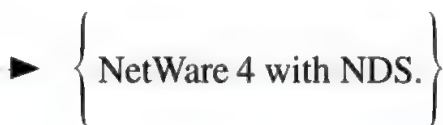
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Client/Server and (What Else?) the Internet

By David S. Linthicum

The World Wide Web is an excellent model for the largely proprietary client/server industry. Web clients all run standard front-end software (such as Netscape), and all support HTML. All Web clients and servers employ the standard HTTP middleware layer, and all communicate with one another independent of the hardware and OS. This infrastructure has been in place for a long time, and end users know how to use it. Here's a quick look at how we use client/server on the Web today, and how we'll use it tomorrow.

Client/server is already a big part of the Web. Web clients can link into a server, which in turn links to a database server to provide all sorts of information to clients. Generally, this functionality is provided through the Common Gateway Interface (CGI) protocol. CGI extends the capabilities of HTML, which is more adept at processing text and images than information.

Most Web servers, such as NCSA's httpd and CERN's httpd, support CGI. Using CGI, developers can create powerful scripts in many languages (including C++ and Perl). The scripts, which operate independently of the Web server, provide information to Web clients in an easy-to-understand manner.

CGI scripts offer gateways to client/server database support as well, through the use of search engines. These engines receive information from the HTML forms sent to the clients and pass that information to a CGI script, which in turn passes the information to a database server as an SQL statement. When the database server responds to the request, a CGI script converts the results into an HTML document, which is sent back to the client.

With the advent of Java and Microsoft's competing OLE

strategy for the Web, along with the many Internet development tools already available, client/server applications development on the Web is destined to become our favorite pastime. Java brings true application functionality to Web browsers, allowing applet developers to create such dynamic applications as a financial calculator and animation. Java applets carry their own middleware that enables them to link to resource servers such as real-time financial information or sports scores. Java differs from the HTML and CGI approach in that the applets, once downloaded, can link directly with a database server on the Internet. They don't need a Web server as an intermediary.

The proposed JavaScript is really "easy Java." It allows people with no programming experience to build Java applets quickly. Netscape's LiveWire Pro adds support for JavaScript connectivity to high-performance relational database servers, including Oracle and Sybase. The Netscape Navigator 2.0 Web browser supports Java, and Netscape Navigator Gold adds support for JavaScript.

Not to be outdone by Sun, Microsoft announced last December that it too would provide an easy-to-use client/server development standard for the Web. Microsoft is counting on a stripped-back version of its successful OLE application component, with added security, to provide the same functions as Java applets. The new OLE controls (OCXs) let users create their own OLE applets using available development tools, including Visual Basic and Visual C++. The sheer strength of Microsoft could propel OLE for the Internet past Java. But the yet-to-be-released Explorer 3.0, Microsoft's Web browser, will be one of the few browsers that supports Microsoft's Internet strategy. Microsoft's Internet Information Server (IIS), scheduled to ship by the time you read this, provides integration with other Microsoft BackOffice applications.

base server also has to secure data, optimize database queries, provide caching, and furnish a location for the data dictionary.

Two other important features to look for are the server's ability to provide referential integrity and two-phase commit. *Referential integrity* is a mechanism that ensures that every foreign key matches a primary key. The *two-phase commit* guarantees that your data won't crash even when your hardware does.

Stored procedures, triggers, and rules allow developers to program the database server itself and thus provide another location for application logic. *Stored procedures* are a collection of SQL statements and procedural logic that developers can compile and store on the database server as objects. Client applications can execute stored procedures, as well as other stored procedures or triggers, by sending a message to the database server.

Triggers are stored procedures activated automatically by data-related events that the

database server encounters. A *rule* is a special type of trigger that checks the data before inserting it into the database.

Most implementations of stored procedures, triggers, and rules are proprietary, and capabilities vary. SQL Server can fire only a single trigger for an insert operation, but CA-OpenIngres supports multiple triggers. What's more, the SQL procedural extensions are vendor-specific.

Applications Development Tools

The goal of every client/server development tool is to make client/server application construction quick and easy. Rapid application development (RAD) tools create applications with built-in links to any number of database servers.

Hundreds of client/server tools compete in this fast-growing market. Some of the top tools for Microsoft Windows clients

are Borland's Delphi Client/Server Suite, Symantec's Enterprise Developer, PowerSoft's PowerBuilder, Gupta's SQL Windows 5, and Microsoft's Visual Basic.

Each development tool takes a proprietary approach, but most provide the same basic features: database middleware, a database design facility, a repository, object-oriented development, GUI designers, a high-level programming language, and mechanisms for application distribution.

Middleware services indicate that the tools come with native and ODBC links to most major database servers. The developer needs only to load the appropriate drivers and provide the database server name and log-on information; the development tool handles the rest.

DESIGN FACILITIES

Nearly all these tools provide an easy-to-use graphical depiction of the physical database structure that the developer uses to create or alter the structure of the data-



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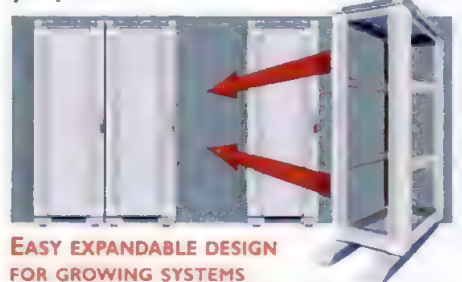
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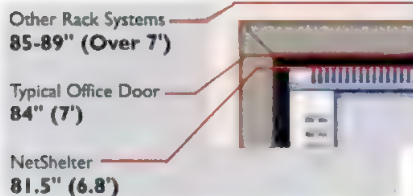
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base. It allows developers to perform such operations as adding database elements, linking tables, and sending changes to the database server as SQL statements.

Repositories are places where many development tools, such as Compuware's Uniface, maintain information about database elements important to the application. In addition to basic information, a repository might store business rules associated with a data element.

Once the developer enters this information into the repository, the data element will automatically take on these characteristics throughout the application using the tool's inheritance mechanism. Most tools can automatically create a default repository using the physical database schema on the database server.

RAD tools build on the repository concept of propagation of data element characteristics through the use of inheritance. All tools build their development environments around their own view of the object-oriented model. Most support inheritance,

polymorphism, and encapsulation but do so in their own special ways. PowerBuilder, for example, uses *single inheritance*, which allows changes to a parent object to exist automatically in its offspring. Gupta SQL Windows uses *multiple inheritance*, in which methods and data from two objects feed into a single object.

Tools also provide interface designers with which developers create data windows, data entry forms, menus, and other components of a GUI application. Interface designers provide a palette of standard GUI controls that developers can drag onto custom windows. Most tools can extend the number of controls available through the use of Visual Basic Custom Controls or OLE Custom Controls, which are available through third parties.

Though a developer can do most applications development using the repository and the interface designer, there is always a point at which the developer needs to add code. All tools provide some soft, high-level (4GL) programming language

for this purpose. PowerBuilder offers PowerScript, a Basic-like 4GL. Some tools use lower-level 3GL languages.

Finally, these tools need to provide some way to distribute applications to end users. Again, each tool takes its own approach. PowerBuilder 4.0, for example, runs applications using a p-code interpreter and requires that the executable exist on the client system along with several DLLs to provide a runtime environment. The same goes for Visual Basic. Delphi Client/Server Suite generates a native executable and requires no interpreter.

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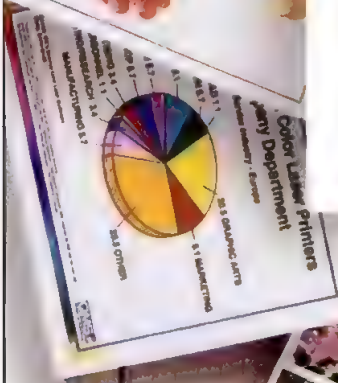
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Three Tiers for Distributed Computing

By David S. Linthicum

Traditional client/server is simple: The client sends requests, and the server responds. Because the client and server are often different computers, they can split up—or share—the processing load to get things done more quickly. The client processes the interface and interacts with the user; the server (usually a database server) processes the requests for the client. Most client/server development falls into this traditional two-tier model.

But although the two-tier client/server model is fine for small workgroup applications with fewer than 100 users (depending upon what the

applications are doing, of course), most two-tier architectures cannot scale much beyond that. The server operating system becomes so saturated with managing the numerous server connections that it simply dies of exhaustion.

The three-tier model solves the scalability problems. Using the three-tier model, the client and the server remain, but an additional middle tier manages transactions much more effectively. This allows developers to scale to the enterprise.

Transaction-processing (TP) monitors provide the horsepower in the middle tier and are the backbone of most three-tier client/server systems. TP monitors, such as IBM's CICS/6000, NCR's Top End, and Novell's Tuxedo, provide various application services that include the ability to route transactions across diversified systems, provide load balancing and thread control, and restart systems and transactions after failures.

More than just middleware, TP monitors provide an independent location for business processing as well, and they can connect to database servers. As the name implies, TP monitors break up complex applications into smaller units, called transactions, and they ensure completion of the transactions. The most significant feature of the TP monitor is its ability to

funnel database requests. A three-tier client/server system that employs a TP monitor can manage the database request of more than 1,000 users, employing only a handful of database server connections.

But beware: Developing client/server systems that use TP monitors is complex. Most of today's popular 4GL client/server tools don't know how to interact with TP monitors, and even if they do, developers must learn how to build applications without direct access to the database schema.

TP monitors are not the only three-tier game in town. Application-partitioning tools and distributed objects provide

similar scalability features in a multitier model. Application-partitioning tools, such as Dynasty Technologies' Dynasty and Forté Software's Forté, enable developers to partition a single logical application dynamically over several tiers (or servers). Because the processing load is distributed across various processors, application partitioning provides the ultimate in client/server scalability.

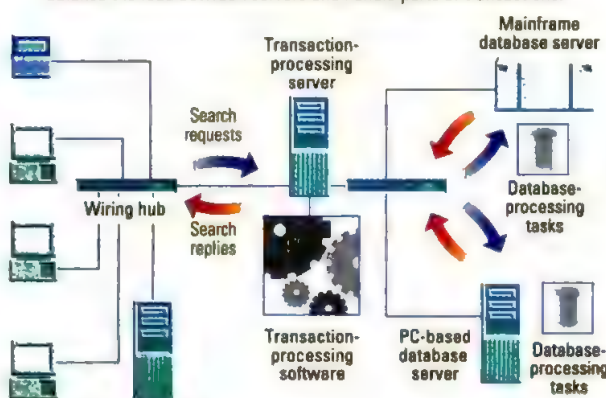
Using application-partitioning tools, the developer need only design the application on a single client PC, then relocate portions of it (application objects) to any server accessible by the

network. It's as easy as dragging an application object to a server icon. In the background, the application-partitioning tools generate and compile native 3GL code on the target servers to perform the processing. With application partitioning, the number of tiers is limited only by the number of available computers.

Although TP monitors and application-partitioning tools deliver on multitier client/server development today, distributed objects could very well be the preferred mechanism for distributed client/server tomorrow. The basic idea is that a binary object standard allows various objects from various vendors, running on various platforms, to work together to create a multitier client/server application.

The Three-Tier System

Transaction-processing (TP) monitor software is in effect sophisticated middleware that holds and manages requests and replies that flow between clients and database servers. In this three-tier model, the TP monitor can balance the load between servers and handle parts of transactions.



ers such as Crystal Reports Standard, from Crystal, a Seagate Software Company, and R&R Report Writer, from Concentric Data Systems, reside on Windows clients. To gather data for reports, they communicate with database servers using native database middleware or ODBC. With criteria set by the user, the report writer generates the database request and sends it to the server or servers. It processes and cor-

rectly formats returning data.

Client/server or SQL report writers offer a hodgepodge of features and functions, with few emerging standards. Most provide the same basic services: database connections, view customization, report design, report testing, database query generation, and applications development.

To get the data it wants, the report writer needs to communicate with the database

where the data resides. Today's report writers can communicate with any number of database servers; this allows users to link physically distributed, heterogeneous databases to create a single report.

Report writers can also read database schema information and create a local repository from which reporting tools can provide menu-driven database information. Some report writers allow users to

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Key#98396



In OSs, Size Counts

By David S. Linthicum

Scalability of the operating system is especially critical to client/server computing. An OS simply must handle the increasing processor and user loads as an application inevitably grows over time. As the load increases, it's usually the server side that bogs down. Interestingly, though, the upper limit of a database server really depends on what the clients are doing. For example, just a handful of clients running reporting or OLAP tools can quickly bring the most powerful database server to its knees.

Database servers are fat applications that place a tremendous load on the underlying OS and processors. Server OSs must provide such advanced services as memory protection, semaphores, high-performance file systems, and virtual memory management, as well as support for threading, multitasking, and interprocess communications (IPCs). They need all that horsepower because each time a client links to a server or process, a thread is launched to support the connection. Each connection requires memory and processor resources just to maintain the link, not to mention what's needed to complete the database request.

It is this two-tier, one-to-one, client-to-connection ratio that limits the server's ability to scale. A server OS can quick-

ly run out of resources as clients connect. Generally, most database servers can support no more than 100 connections at a time. Your server's upper limit depends on your choice of processor architecture, how many processors you have available, and your OSs.

In the world of client/server there are two prevailing processor architectures for servers: RISC and Intel. RISC is the traditional choice for Unix servers—IBM's RS/6000 series running AIX and Hewlett-Packard's 9000 series running HP/UX, for example. But that's changing. Windows NT runs on Intel machines, but also on RISC systems. Generally speaking, RISC servers are a few performance clicks ahead of Intel-based servers, but they cost between \$15,000 and \$50,000.

Intel-based servers are catching up quickly, too. With the Pentium, which uses superscalar RISC-like technology, Intel is nipping at the heels of RISC. And many advanced OSs run on Intel machines, including some Unix variants. Even so, Unix could eventually take a back seat to Windows NT, which combines the advanced features of Unix with Windows ease of use.

The ultimate in database server scalability is the multiprocessor server and the OSs that run on it. Multiprocessing versions of Unix and Windows NT support multiprocessor hardware by allocating the load evenly across processors.

customize the repository to fit a specific view of the business, creating a logical schema that remaps the physical schema.

Esperant, from Software AG, for example, allows developers to create special representations of databases that are easily understood by users. This keeps users from having to understand and deal with overly complex database structures when searching for information.

All reporting tools walk users through the design and generation of a report. Many provide templates or prebuilt generic reports. Most report writers run in Microsoft Windows GUI environments and offer WYSIWYG report designers.

Report writers allow developers to select data elements from a menu and paste them directly on the report. They support fonts and special effects as well as bit maps. Report developers can create logical calculated fields and provide totals and subtotals. Many reporting tools offer powerful 4GLs, allowing developers to control the behavior of a report for the user.

Query-generation facilities in report writers make it easy to assemble SQL query statements. Query facilities allow developers to select, order, join, and apply logical operators to a query. Usually the reporting tool creates the SQL statement automatically, so SQL expertise isn't required.

Reporting tools support applications development in one of three ways: as

standalone reports, as embedded objects, and as components of an application. Many reporting tools provide a complete development environment with runtime-report distribution mechanisms.

Runtime reports provide users with click-and-run reports without having to distribute the complete report writer. Some reporting tools allow reports to be distributed as OLE objects that users can embed in other applications.

Reporting tools also work closely with applications development environments, and most client/server application-development environments provide a proprietary reporting tool or bundle a third-party tool. PowerSoft's PowerBuilder, for example, has its own report writer, which is integrated with the development tool.

To test the reports, most report writers provide a test facility in which developers can view the reports as they would look on paper. Most allow report testing without a connection to live data.

Online Analytical Processing Tools

A new entry in the client/server arsenal, online analytical processing (OLAP) tools significantly cut the time it takes to serve up information. OLAP doesn't require complicated development and is quickly becoming the favorite pastime of

information-hungry executives.

OLAP tools empower end users to examine, analyze, and summarize corporate data with a few mouse clicks. They provide a natural way to look at data and give decision-makers the power to get information out of the database servers that they really need—and avoid the hassle of traditional query languages and tools.

POWER TO THE PEOPLE

OLAP has no clear definition. Basically, most OLAP products provide point-and-click access to multidimensional data from PCs connected to traditional database servers or proprietary multidimensional databases. Some OLAP tools, such as BrioQuery for Windows, from Brio Technology, and PowerPlay, from Cognos, provide just the OLAP client side.

Other OLAP products, such as Essbase Analysis Server, from Arbor Software, offer just the multidimensional server side. A few OLAP products, such as LightShip, from Pilot Software, provide the multidimensional database server and client.

Reporting tools, close relatives of OLAP tools, also allow end users to extract information from the database. But reporting tools require a rudimentary knowledge of the database to create database queries, form relations, and format the queries into meaningful reports

and graphs. Although they can get at the same information as OLAP tools, reporting tools work best in the hands of developers.

OLAP, by contrast, provides a multi-dimensional view of the database that resembles the way the end user understands the business. OLAP offers a natural drill-down interface that allows users to move through layers of data abstractions until they find what they need. Once found, data can be printed, graphed, or imported into documents or spreadsheets.

For example, an executive seeking sales information by various categories for an upcoming board meeting can click on the sales dimension and then on such dimensions beneath it as sales by product, sales by industry, sales by salesperson, and so on. After selecting one of these categories, the executive can search further by selecting additional dimensions until the required information is found. The executive need not understand either the structure of the database or the relational database technology, or even know exactly what to look for; the OLAP tool acts as a guide.

FLEXIBILITY

OLAP's principal selling point is flexibility. By clicking on the data, end users can combine data in any order for any reason. And OLAP tools don't limit what the end user can do with the data. End users can display data at any level of aggregation and retrieve results over several time periods.

Most OLAP tools manipulate data as if it resided in a giant cube with each side of the cube representing one dimension of the database. Inside the cube are all the intersections of the dimensions. They allow the user to examine every possible combination of data by slicing and dicing the cube with an OLAP tool.

OLAP products store data for multidimensional analysis in basically two ways. First, a true multidimensional database server, such as Essbase Analysis Server, actually stores the data as a multidimensional array, called a *real cube*. The other, more convenient way is to maintain data in relational databases, but to map that data so it appears to the OLAP tool and the end user as multidimensional data. This is known as *virtual cube*, in which the illusion exists at the metadata layer.

OLAP is becoming one of the bigger success stories in the client/server marketplace, because while other prod-

ucts seek to make the client/server world more complex, OLAP makes it easier.

Middleware

This is the glue in the construction kit. Middleware is the client/server software that enables client applications and packages to connect easily to resources on servers. They come in many varieties but perform the same task: releasing apps from the complexities of OSs, network protocols, and resource servers.

Like client/server, middleware is another overused buzzword, but it is critical in the development of client/server systems. Middleware sits between the client and the server. It converts data and allows very different systems to get along.

Middleware begins with an API on the client that can invoke services remotely. It handles the transmission of the request and the resulting response; it doesn't provide an actual service such as interface and server processing, though.

Middleware categories include database middleware, transaction processing (TP) monitors, remote procedure calls (RPCs), message-oriented middleware (MOM), and object-request brokers (ORBs).

The two basic types of middleware are native database middleware and database-generic middleware. *Native database middleware* is a proprietary access mechanism for a particular database server. *Database-generic middleware*, such as Microsoft's Open Database Connectivity (ODBC), enables applications and packages to communicate across different SQL dialects, network protocols, and native APIs, using common interfaces.

Although the database industry is standardizing database access, it's still a hodgepodge of proprietary access mechanisms. So hiding native database access behind layers of middleware makes sense.

ODBC is a Microsoft Windows-based call level interface (CLI) that uses 54 standard API calls. ODBC can translate the calls into many native database dialects using

database-specific ODBC drivers.

EDA/SQL, from Information Builders, is an example of a SQL gateway that can translate SQL calls into a common industry-standard format and protocol (FAP), providing a common protocol between client and server. EDA/SQL can access more than 50 relational and nonrelational database servers, the most in the industry. An ODBC driver is even available to access the EDA/SQL layer, which can access an EDA/SQL-supported database server.

TP monitors (see related sidebar) allow clients not only to connect to servers but to manage transactions from client to server and back again. Tuxedo, from Novell, and Top End, from NCR Corp., for example, are different from traditional middleware. They provide transaction-tracking services, load balancing, recovery services, and the ability to restart servers and

queues automatically. TP monitors provide another location for application processing and have led many client/server systems into the world of three-tier client/server computing.

In contrast to RPCs, MOM lets developers communicate with servers asynchronously and doesn't suspend the

Middleware's future may be in the world of object request brokers—mechanisms that allow objects to send and receive messages from other objects.

client applications. Because it uses messages and queues, MOM doesn't require a dedicated network connection and works well on slower WAN connections. IBM's MQ series is an example of a MOM product.

The future of middleware may be in the world of ORBs, mechanisms that allow objects to send and receive messages transparently from other objects that are local or connected by a network. ORB services provide the foundation to build distributed-object applications, with granular levels of interoperability across heterogeneous distributed environments.

The Object Management Group's Common Object Request Broker Architecture (CORBA) is now in the process of defining ORB standards. Today, only a few ORB middleware vendors, such as Teknekron, provide ORBs for use as middleware. But this part of the market will continue to grow. □



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HAWK 2XL	ST3218E	3.143 GB	Ultra SCSI, 16 bit	up to 40 MB/sec	5411	9/10.5

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First Looks

HANDS-ON REVIEWS OF NEW SHIPPING PRODUCTS

GROUPWARE

Cruising with New Groupware

By Frank J. Derfler

With Cruiser 1.1, from Connectware, comes a new software category: small-office groupware. Like those in other groupware products such as Lotus Notes, Cruiser's core functions are e-mail and scheduling. Most groupware products let people communicate, schedule, and coordinate their activities; Cruiser just does it more economically.

Windows for Workgroups and Office 95 are probably thinking: "Wait a minute. Microsoft already rolls e-mail and scheduling into Windows for Workgroups and Office 95, so why pay for Cruiser?"

First of all, Cruiser is an excellent add-on to PCs running older versions of Windows. The list price is \$149 per copy, but you can get it through many software catalogs for \$79.95. Second, Cruiser is more flexible

Cruiser conforms to Microsoft Mail API (MAPI), so if you have a Microsoft Mail system, Cruiser can use it to transport messages between mail systems, and it can act as a Microsoft Mail client. Cruiser should also work with Microsoft's Exchange Server.

Compared with larger, more expensive workgroup products, Cruiser is quite flexible about the configuration of the network it runs on. It doesn't directly address any networking protocols, so it will work over any network operating system. Cruiser doesn't even need a file server; it can function as a peer-to-peer system across a LAN or through regularly scheduled dial-up connections. But if the clients aren't connected to a PC acting as a file and Cruiser server, you lose the advantages of store-and-forward mail delivery and the ability to

check everyone's calendar easily for scheduling conflicts.

Cruiser doesn't need any special mailbox software; the client software works over a LAN or across a dial-up connection. A PC running file sharing under any network operating system and Windows can be a Cruiser message-and-fax server.

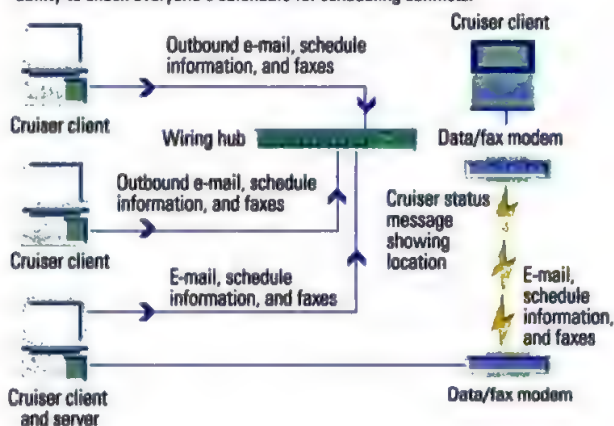
This system doesn't take much to install and run. Cruiser runs on any PC that runs Windows. Because of its fax-handling capabilities and the direct e-mail calling, you'll get more out of Cruiser if each PC has a data/fax modem attached. Individuals are responsible for maintaining their own mailboxes, so an administrator just has to remind people to delete old faxes and messages.

Cruiser focuses more on individual productivity than the

Continues on page NE30

How Cruiser Works

For a small office, Cruiser provides the core scheduling, e-mail, and faxing capabilities that products like Lotus Notes have, but at a much lower price. Cruiser is flexible and will work over any NOS. If you set up one PC to act as a file and Cruiser server, you'll gain store-and-forward mail delivery and the ability to check everyone's calendars for scheduling conflicts.



Though Cruiser may lack the enterprise-wide features (such as sophisticated management and global naming systems) of other products, it offers low cost, simple installation, and easy maintenance. To try Cruiser for free, go to Connectware's home page (<http://www.connectware.com>).

Those of you with Microsoft

and less demanding than Microsoft's Mail and Schedule+.

Cruiser also has nice utilities for reading and creating faxes that you don't get in Windows for Workgroups. It has a flexible base of rules for creating procedures such as forwarding mail. It makes excellent use of graphics, and the scheduling system is very easy to use.

VIDEOCONFERENCING SYSTEMS

High Price for Virtual Video

By Les Freed

Fueled by improved interoperability and dropping prices, the LAN/WAN videoconferencing market is heating up. Prices have dropped so low that some first-rate systems are now available for less than \$2,000 per seat.

So why is newcomer ImageLink charging \$4,700 for Virtual Desk PC, a LAN videoconferencing system? According to the company, the system uses a proprietary hardware-based, pixel-refreshing technology that results in sharper, clearer video with less time lag. In other words, when your conference partners move, their images move too, at virtually the same time. That isn't always the case with other systems. In

addition, Virtual Desk's audio is perfectly synchronized with the picture, another innovation.

Virtual Desk can operate over many LAN transmission media, including Ethernet, FDDI, and Token-Ring. If you need wide area conferencing, ImageLink can provide optional interfaces to connect Virtual Desk to ATM, ISDN, Switched-56, and T-1 services. Virtual Desk is fully compliant with the ITU H.320 videoconferencing standard. We successfully connected our test unit to several other brands of conferencing gear via ISDN service.

The Virtual Desk system includes a proprietary video compression/decompression (codec) board, a monitor-top

Continues on page NE30

NETWORK EDITION

First Looks

Cruiser

Continued from page NE29
bigger workgroup systems. It has good tools for handling faxes, some project management features, and the ability to import names and phone numbers from contact management programs such as Symantec's ACT! You can create a To Do list and integrate it with your list of recurring appointments.

You can also dial your voice calls from Cruiser's address book if you have a local modem that Cruiser can use to dial.

An interesting part of Cruiser's design is the individual status feature. Individuals can fill out a form describing where they are, whether they are available, and how to reach them. A quick modem call posts this status information for anyone who clicks on that particular name in

the address book.

If your office has a PBX phone system, you'll appreciate that Cruiser complies with the Microsoft TAPI protocol. It can initiate calls and conferences with and manage the actions of a TAPI-conforming PBX.

Cruiser offers an affordable and relatively simple way to bring the benefits of group scheduling and e-mail, along with some personal productivity

tools, to your organization. As we point out in this issue's review of PhoneWorks, Connectware is a big, diverse company that should be around to support Cruiser and help it to evolve.

Cruiser, Version 1.1. List price: \$149; street price: \$79.95. Connectware Inc., Richardson, TX; 800-357-0852, 214-997-4111; fax, 214-997-4309; <http://www.connectware.com>. Circle 952 on reader service card.

Virtual Desk PC

Continued from page NE29
camera, and a headset.

Installation is fairly simple, but you'll need a PC with a compatible video overlay card. ImageLink has its own combination VGA/video overlay card, but the system can operate with Creative Lab's Video Blaster and a few other overlay cards. Given the potential for incompatibilities, we would opt for ImageLink's own card.

The Virtual Desk codec board installs in a slot next to your video overlay card and connects to it via a ribbon cable. You plug your monitor into the codec instead of the video card. This arrangement allows Virtual Desk to overlay the conference video on your video card's output. The conference video is handled entirely on the codec board, greatly reducing the burden on the PC's CPU. In fact, ImageLink says that Virtual Desk will run on a 386-based system.

Now for the bad news. In its full-motion mode, Virtual Desk requires about 2 megabits per second of LAN bandwidth continuously. If you have more than one Virtual Desk session connecting on the LAN at the same time, you'll notice significant performance slowdowns. You can reduce the amount of LAN bandwidth required by reducing the frame rate of the transmitted picture, but the motion won't be as smooth, and the quality won't be as good.

A competing product, C-Phone (\$1,995 per worksta-

tion), from Target Technologies, sidesteps the LAN bottleneck problem by sending analog video over the unused pairs in 10BaseT twisted-pair cabling. Target's system requires special 10BaseT hubs for the conferenced LAN workstations, but C-Phone provides a higher quality picture at about half the cost of Virtual Desk.

We were impressed with the quality of the Virtual Desk system. The camera tended to "bloom" on high-contrast scenes, but that's typical of the single-chip CCD cameras common to conferencing systems. Virtual Desk provides two external video inputs so you can connect any NTSC-compatible video device. For really high-quality video, you can use an inexpensive camcorder instead of the provided camera.

Virtual Desk's conferencing software is straightforward and easy to use. A split screen allows you to see yourself and the party you called. This is a nice touch because you can make sure that your face is visible to the other party. Virtual Desk also comes with TalkShow 3.0, a full-featured document-sharing program.

If you need first-rate LAN videoconferencing over your existing LAN cabling, Virtual Desk fills the bill—but it's a big bill to pay.

Virtual Desk PC. List price: \$4,700. ImageLink Inc., Boulder, CO; 800-420-1110, 303-449-4711; image4@telerama.lm.com. Circle 961 on reader service card.

VOICE MAIL AND FAX SYSTEMS

Connecting the Works

By Frank J. Derfler

Do you want your small business at least to sound like a multinational corporation? Giving callers the impression of corporate efficiency and prosperity by adding a call-handling and voice-mail system to your PC is pretty easy. You've heard these systems in action too many times: "For accounting, press one. To place an order, press two." The messages are a user-provided add-on, but with features such as fax-on-demand and private messaging, these systems can save time and improve productivity.

Connectware recently rolled out PhoneWorks 28.8, a product that will fulfill your desire to have a sophisticated-sounding call-handling system. It has inte-

grated call-routing, inbound and outbound fax, fax-back, speakerphone, and voice mail capabilities on top of a 28.8/14.4-Kbps data/fax modem. The modem is an internal 16-bit ISA bus card, with the necessary array of error control and compression protocol talents, including V.42, V.42bis, MNP4, and MNP5.

If you are primarily interested in the voice and fax capabilities of PhoneWorks and don't need a 28.8-Kbps modem, you can avoid paying \$299 and pay only \$169 for PhoneWorks 14.4. This less expensive version has all the voice and fax features, and a modem that is probably good enough for everything except Web surfing.

PhoneWorks is designed to

Crosstalk



Gail Sheffer

“Don't expect too much, Frank. PC-based CTI has evolved as a useful tool, but it's not a panacea. It sounds as if you want to make a PC into a PBX, and that's something you don't want to do halfway. The ability of these products to handle faxes smoothly for both individuals and groups is a useful and powerful addition to productivity.”

“This comes so close, Gail, but it's not a quite a win; it's the perpetual story of PC-based CTI. In this instance, PhoneWorks' single phone line limits it to the small office and stunts its future growth. With two or more lines, the call-routing and voice mail would be much more useful.”



Frank Derfler

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Is the Internet always so hard?

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Without on-line news, we're no one.

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You ain't anybody unless you're on the Net.

What do you mean I can't access that?

Can we view images?

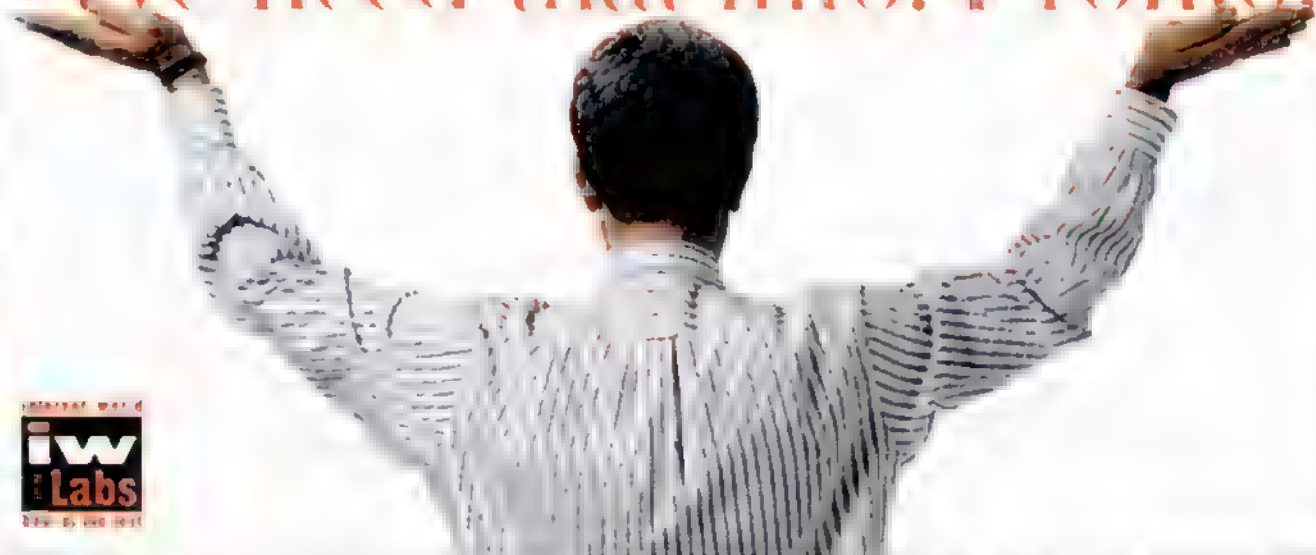
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Why do I have to learn all these crazy voodoo commands?

This is so confusing.

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Emissary is standards-based and is built to protect your investment in hardware, software, and networking infrastructure. And, by the way, last December, it was named "Best of the Test" by Internet World magazine.

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 **Attachmate**

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CIRCLE 926 ON READER SERVICE CARD

NETWORK EDITION

First Looks

use only one phone line. So if your office has grown beyond a single line and you want voice mail, you'll be better off going to the telephone company and subscribing to a similar service.

With PhoneWorks handling your calls on one line, callers get a busy signal if the line is in use. With a telephone company service, callers go to voice mail when your lines are busy. If you've activated your telephone company's Caller ID option on your phone line, PhoneWorks presents the phone numbers of calling parties. You could pay more than \$100 for a simple device that displays only Caller ID.

As the chairman of a local volunteer civic committee, I saw an immediate use for PhoneWorks. I installed the system on a surplus 486/50 PC running under Windows 3.12, gave it a

phone line, and set up mailboxes. I assigned each committee member a private mailbox and created a menu of information messages. I had to go through the installation program twice, because the first time I couldn't record. A later discussion with Connectware's tech support confirmed that you have to be careful about the sequence of data entry to get all features to work in harmony. Installing and programming the system took about 2 hours; planning and recording messages took some additional time.

After installing the system, we publicized the number. People in the community called in to get meeting information, leave voice messages for committee members, and pick up messages. By working through the menu using a push-button telephone, callers could listen to special

committee bulletins, or historical or background information. We loaded a map of a parade route into the fax system, and dozens of people called in to have it faxed back to them.

PhoneWorks is also a desk telephone that includes a great-sounding, full-duplex speakerphone. The package includes a stylish desk microphone, but the quality of the speaker leaves something to be desired. The software provides easy control of the telephone, including the volume. In addition, preprogrammable dialing keys are included, and a directory of names and numbers makes it easy to place calls.

The software gives you good visibility of new and saved voice mail messages and faxes. The fax viewer can rotate and zoom, but it cannot OCR a fax into an ASCII text document.

A logging system shows the size, date, and other information about old and new messages and faxes, and a schedule of faxes slated for transmission.

Connectware loads PhoneWorks with software for the Internet Phone service, an Internet provider, and other online services, but you won't buy the product for that. PhoneWorks' appeal is its economy and efficiency as a desktop voice mail and fax system. And for you worriers, Connectware is a substantial company with fingers in ATM and LAN products, mainframe operations, and Token-Ring switches and routers.

PhoneWorks. List price: PhoneWorks 28.8, \$299; PhoneWorks 14.4, \$169. Connectware Inc., Richardson, TX; 800-357-0852, 214-997-4111; fax, 214-997-4309; <http://www.connectware.com>. Circle 951 on reader service card.

MULTIPLE ACCESS By Robert P. Lipschutz

Turtles, Snails, and Your PC



Did you ever wonder who would win in a race between a snail and a turtle? That's what it's like watching the cable companies and the telephone companies vie for dominance in the high-speed data-access home market. The Internet's promise of rich content in the form of

real-time video and virtual reality will remain a dream to home users until the appearance of cable modems or asymmetric digital subscriber line (ADSL).

The snails (or cable companies) enter the race with little experience in data communications, having grown up in broadcast TV where two-way communication is unknown. The closest thing is the telephone call you make to order a pay-per-view movie. But the cable companies hope to change this with a new data service that works through cable modems.

Cable modems work with the existing hybrid fiber-coaxial cable plants that already bring cable TV into your home. A T-connector will split the incoming cable so that it runs to both your TV and your PC. An Ethernet or ATM adapter in your PC will provide the connection to the cable modem.

Most cable modems are designed to carry large amounts of traffic downstream from the cable company to the end user, and smaller amounts upstream from the cable modem. We've

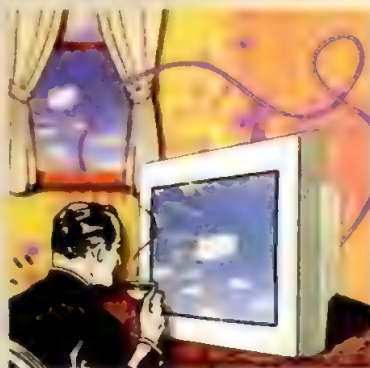
seen cable modems that provide up to 27 Mbps from the head end (the cable company) to the home. That's three times as fast as Ethernet, the most common LAN connection! Typically, the reverse direction works at speeds of between 100 Kbps and 2 Mbps. Digital, Hewlett-Packard, Intel with Hybrid Networks, Motorola, and Zenith Data Systems all have cable modem prototypes.

And then there are the turtles—the telephone companies. These minimonopolies have been content with the same old, same old for the past 10 years. What would motivate them to do something now? Why, the snails, of course! Snails look very aggressive to turtles. So the telephone companies will continue to promote ISDN in the short term while developing a new connection standard, ADSL, for the long term.

Like cable modem technology, ADSL will provide larger bandwidths—up to 8 Mbps—downstream and smaller bandwidths upstream. ADSL will be designed to work over standard telephone lines. The current copper phone lines were not designed for the fast speeds we're talking about, and serious technical challenges remain. The silicon that finally succeeds in solving the technical problems may come from the phone companies or, more likely, from smaller firms.

We expect to see some cable modem trials in late 1996. But with technical challenges facing ADSL, we don't expect to see the real thing until 1997 or 1998.

Who will win the race between the snail and the turtle? The one that jumps on the back of the racehorse. I'll let you figure out what that means, but here's a clue: What kind of company responds best in a competitive market? (Hint: not a monopoly.)



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New & Improved

NEWS OF ANNOUNCED PRODUCTS AND UPGRADES

By Eryn Brown



Pipeline 130 Routes ISDN, WAN

ADDING TO ITS ALREADY EXTENSIVE LINE OF WAN access devices, Ascend Communications has introduced its latest line, the **Pipeline 130** family of integrated remote access routers.

The products offer WAN connections to a variety of media, including Frame Relay, ISDN, and T1 lines. The units combine routing, CSU/DSU, and ISDN NT-1 functions with software support for bandwidth-on-demand, interoperability, and security features.

There are three Pipeline 130 configurations available: one with ISDN BRI services and a T1 interface (\$1,995), another featuring Switched 56 and DDS56 (\$1,995), and a third with ISDN BRI and DDS56 (\$1,895).

Ascend Communications Inc., Alameda, CA; 510-769-6001; fax, 510-814-2300; <http://www.ascend.com>. **Circle 954** on reader service card.

Gauntlet's New Face

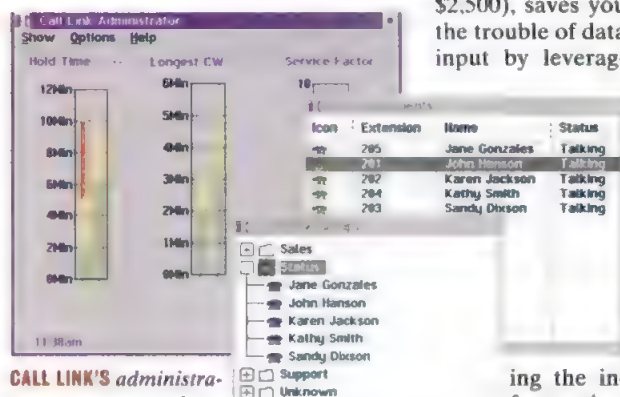
YOU PROBABLY HAVE A firewall to protect your clients. But if you want to make your information servers more secure, look to Trusted Information Systems' latest release.

Gauntlet Internet Firewall, Version 3.1 (starts at \$11,500), now integrates Web and ftp servers on the firewall itself. It also offers a new remote management GUI and secure POP mail and printer service proxies. **Trusted Information Systems Inc.**, Rockville, MD; 301-527-9500; <http://www.tis.com>. **Circle 956** on reader service card.

Call Link Eases CTI Transition

SOMETIMES THE BIGGEST obstacle to upgrading your call center is integrating the numbers, order forms, queue-

ing rules, and other data that direct your operations. Teledata's new CTI system, **Call Link for Windows** (beginning at \$2,500), saves you the trouble of data input by leverag-



CALL LINK'S administration screens provide at-a-glance information.

ing the information

found in your existing LAN database.

The package comes in two parts: the call services processor and the agents. The call services processor runs on a networked PC, connects directly to your existing switch or Centrex, and provides call automation. The agents, which run on Windows or OS/2 PCs, provide an interface for operators and the system administrator. Features include screen pops with incoming-call information, call-center status information, and ready-made response options available through a single mouse click.

Call Link works with the IPX/SPX, NetBEUI, NetBIOS, and TCP/IP protocols. Remote users can connect using any of a number of LAN and WAN technologies.

Teledata Solutions Inc., Downers Grove, IL; 708-620-5298; fax, 708-620-5274; <http://www.tdata.com>. **Circle 955** on reader service card.

HOT PROSPECT

Cisco Bundles Netscape with IJ

Everyone's buzzing about the World Wide Web and the Internet. They're hoping to build new business connections and gather market information over the public wires. Unfortunately, sometimes getting connected to the Internet is a complicated matter. Cisco Systems and Netscape Communications are joining forces to make that process a little easier.

Cisco has begun bundling **Netscape Navigator** with its newly acquired **Internet Junction**

Internet gateway software. The package, which costs \$595 for a five-user license, now provides a complete NetWare-to-TCP/IP solution. The package allows administrators to set up an Internet connection without installing TCP/IP software on each client. It also centralizes connection management and isolates sensitive information on critical servers. Thanks to its Secure Sockets Layer (SSL) protocol-based features, Netscape Navigator provides advanced Internet security capabilities. Naturally, the Netscape software also provides a graphical interface to the World Wide Web and other Internet services.

Internet Junction is available directly from Cisco or as a CiscoPro product distributed by designated VARs.

Cisco Systems Inc., San Jose, CA; 800-553-6387; <http://www.cisco.com>. **Circle 953** on reader service card.



New & Improved



TOKEN-RING JITTER disappears with Transition Networks' new hub.

StackMaster TR Cuts Jitter

JITTER IS A COMMON TOKEN-RING NETWORK PROBLEM where data moves around the ring at intervals that gradually grow uneven, causing timing variations and data degradation. Transition Networks' new hub, **StackMaster TR** (\$1,599), has been designed to eliminate this problem—without making you resort to shielded cable or short node distances.

The StackMaster TR uses a high sampling rate, digital phase locked loop, which retimes and regenerates every signal passing through every port on the hub. This increases allowable distances to 400 meters for STP cabling and 300 meters for UTP cabling.

The hub can work at a rate of 4 or 16 Mbps and is available with an optional SNMP management card (\$795).

Transition Networks Inc., Eden Prairie, MN; 800-526-9267; info@transition.com. Circle 957 on reader service card.

Wireless Windows: Why Not?

NO ONE DOUBTS THAT wireless technologies will change the way we do business. The question is how. One new solution, **Multicruise**,

ZENITH'S CRUISEPAD, an integral part of the new Multicruise system, is a lightweight, hand-held device that can give you wireless access to Microsoft Windows and DOS applications.



from Zenith Data Systems, combines a powerful Windows NT server with ZDS's CruisePAD to provide DOS and Windows apps without the PCs. It costs approximately \$2,300 per user.

Users work with CruisePADs, ZDS's own hand-held wireless devices. The units feature full-size, backlit, touch-sensitive displays. The server software, which incorporates

Safe and Efficient Internet Mail, Pronto

THE OPTIONS FOR SECURE, efficient messaging abound. CommTouch Software has introduced two new products for remote users and system managers, **Pronto Mobile** (\$99) and **Pronto Secure** (\$299).

Pronto Mobile is an Internet mail client with advanced filtering and prioritizing func-

tions. These functions let remote users select which messages and files to download over expensive connections, saving time and money. The package also offers mail synchronization.

Pronto Secure provides plug-in, transparent e-mail security functions. They include

encryption (for MOSS, PEM, PGP, POTP, and S/MIME), password-protection, automated key exchange, and signature authentication.

CommTouch Software Inc., San Mateo, CA; 415-578-6580; fax, 415-578-8580; <http://www.commtouch.com>. Circle 958 on reader service card.

Citrix's WinFrame, typically runs off of a provided dual 120-MHz Pentium machine running Windows NT.

The Multicruise server software also provides extensive network and device management, which centralizes administration at the server.

Zenith Data Systems, Buffalo Grove, IL; 800-533-0331; <http://www.zds.com>. Circle 959 on reader service card.

BRIEFS

Hardware

Once again, there are new hubs from Asanté, the **Asanté Plug and Play 100TX Hub** (\$1,095 for six ports, \$1,795 for 12 ports) and the 16-port **Asanté Hub 1016-IQ** (\$899). The 1016-IQ will replace the company's 12-port Ethernet hub over the months to come. 800-662-9686 Cogent Data Technologies has shipped its third T4 adapter, the **EM440 T4 Quartet Adapter** (\$1,298). A four-port 10/100 server adapter, the Quartet can work with Category 3 or 4 cable. 800-426-4368 The

7400 WAN Champion Access Hub, from TyLink Corp., has three new communications modules. The **Network Executive SNMP Controller** (\$4,295) provides hub management. The **TY 3450N** (starting at \$2,195) is a multiport DSU/CSU module for T1 and fractional T1 lines. The **TY 150N** (\$1,295) is a single-port T1/fractional T1 DSU/CSU. 508-285-0033.

Software

If you need alarm management and forwarding for ManageWise networks, look

to **AlertPage, Version 2.1** (\$795), from Denmac Systems. The package integrates smoothly into the ManageWise Alarm Manager and provides MAPI for GroupWise and Microsoft Mail e-mail systems. 708-291-7760 NetWare administrators grappling with the shortage of IP addresses can now use ON Technology's **IPTrack** (\$995 for 50 IP addresses) to assign and reassign IP addresses as needed. The product, which runs as an NLM, incorporates TCP/IP's Dynamic Host Configuration Protocol. 800-767-6683.

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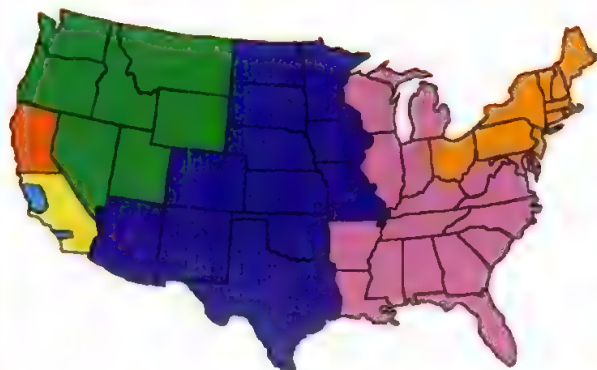
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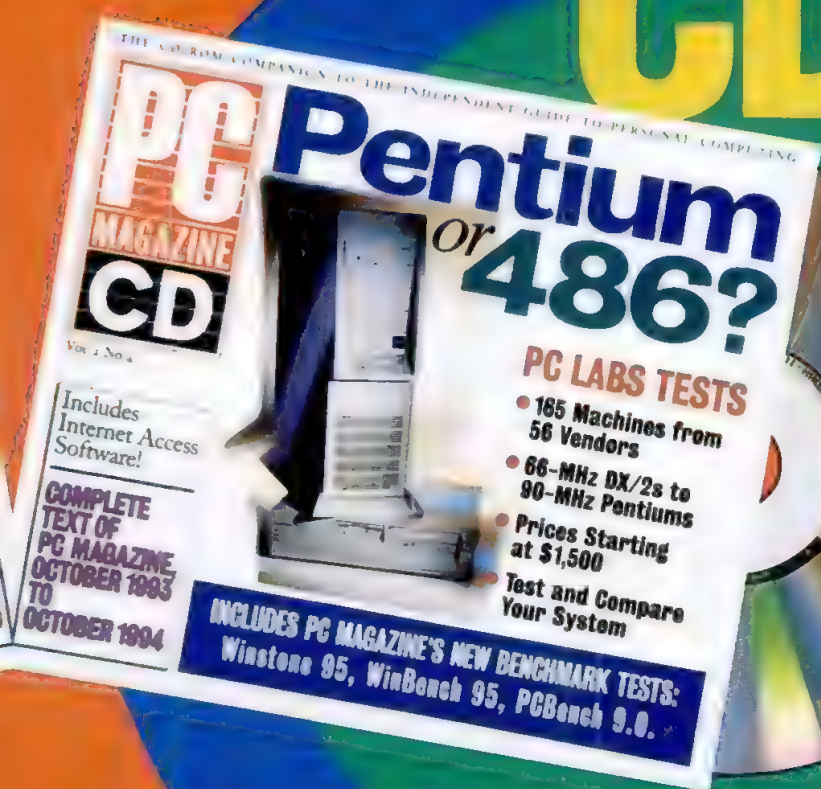
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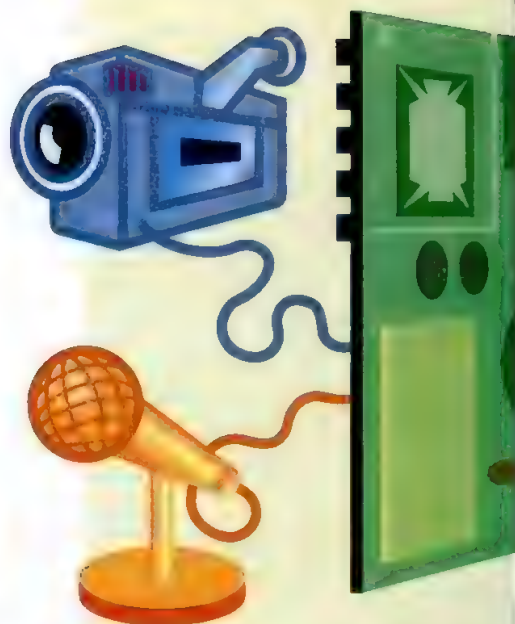
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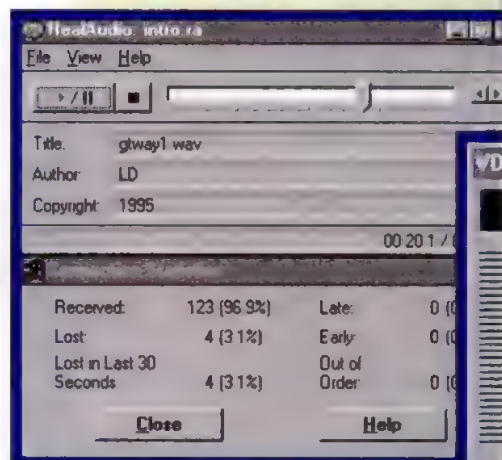
By Jan Ozer



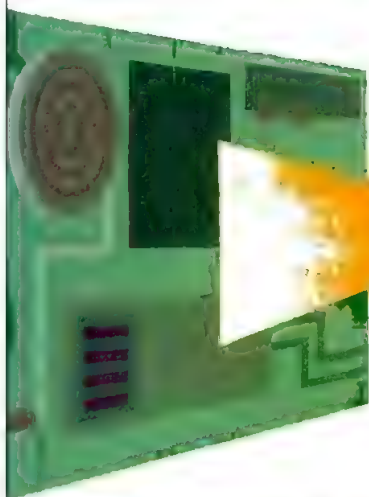
ILLUSTRATION BY GARY BASEMAN; INFOGRAPHIC BY DAVID FLAHERTY

The World Wide Web is no longer silent, and it's no longer standing still. New technologies have brought sound, video, and animation to the staid

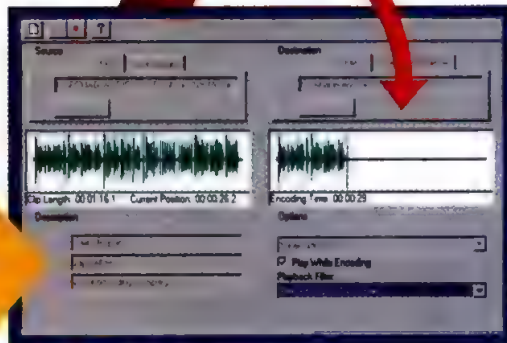
world of HTML text. As a better vehicle to disseminate information (or a way for site for site managers to boost their hits), Web-based multimedia is the cutting edge. The stories that follow show you what Web-based audio and video can deliver and how to use them.



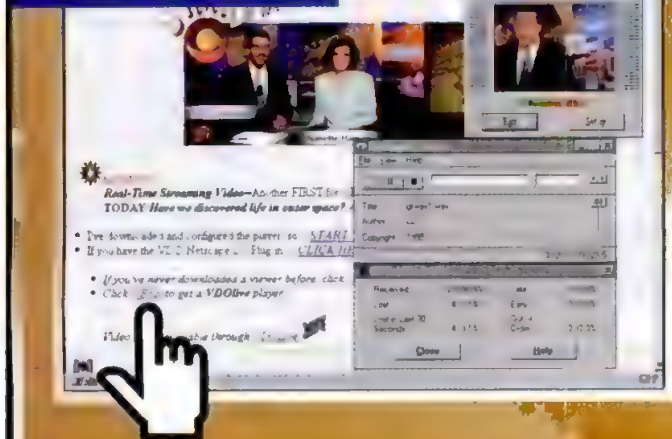
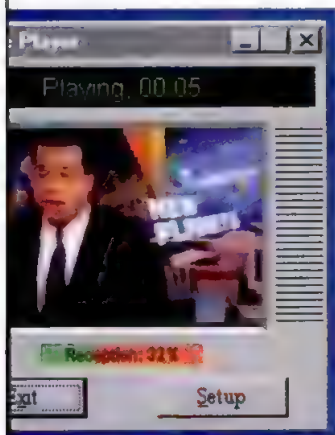
6. REQUESTING the media object. When you click on a media link, the browser sends a request to the media server that returns the token file to your PC. This file tells the browser to spawn the appropriate player, which receives details about the media file you want. Once it's running, the player sends a request to the media server, which transmits the data to the player. After a few seconds for buffering, playback begins.



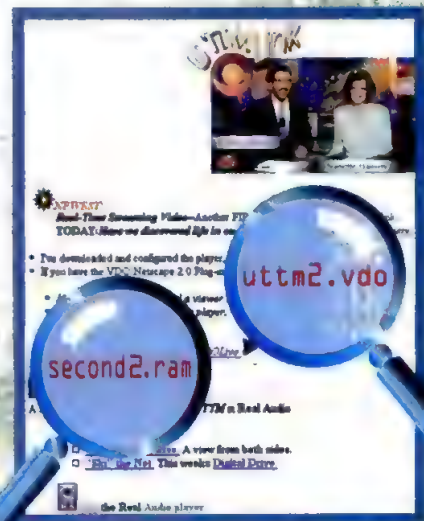
1. DIGITIZING the media files. The first step involves digitizing the audio or video source and is usually done with a standard sound card, a video capture card, or both. Compression is a garbage-in, garbage-out proposition, so you must take care to provide the cleanest possible signal to the encoder.



2. ENCODING the media files. All streaming audio and video technologies compress the data stream to enable real-time delivery over connections as slow as 14.4 Kbps (9.6 Kbps for audio). Encoder software uses proprietary lossy compression algorithms to squeeze data into each vendor's unique compressed format.



3. EMBEDDING multimedia into a Web page. The Web author puts a pointer into a standard HTML tag in the Web page. The pointer links to a token file on the media server. This token file contains type and location data about the media file itself.



4. INTEGRATING multimedia files into the server environment. The Web server must recognize the various multimedia formats to deliver the stream. It does this by registering the file's extension with the server as a MIME (Multipurpose Internet Mail Extensions) type. Several streaming audio technologies and both video technologies we tested also have dedicated server programs that must be configured and initialized.

5. INSTALLING the media player. Prior to requesting the streaming media file, you download and install the media player, which is technology-specific. Then you register the player as a helper application in your Web browser (this may happen automatically during installation). If the player was not present or was incorrectly configured, the browser will prompt you to configure a player when you try to access a media object.

IN THIS REVIEW

► SOUND BLASTS THE WEB	103
Internet Wave 1.0	108
RealAudio 2.0	113
StreamWorks	118
ToolVox for the Web	122
TrueSpeech Internet	125
How We Tested Streaming Audio	104
Editors' Choice	105
Summary of Features	128
► WEB TV TUNES IN	129
StreamWorks	134
VDOLive	136
How We Tested Streaming Video	131
Summary of Features	134
Macromedia's Shockwave for Director	135
Apple's QuickTime VR: Almost Virtual Reality	136
Internet Phones and Videoconferencing	143



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CIRCLE 033 ON READER SERVICE CARD



Sound Blasts The Web

Streaming audio technologies for the Web are up and running. For some sites, the right solution may even be free.

By Jan Ozer

Sound is a great attention getter, one that can lure us to dig deep into an newly discovered Web site. But if we have to wait to download an entire audio file in order to hear any of it, how many of us are willing to hang around for the time it takes?

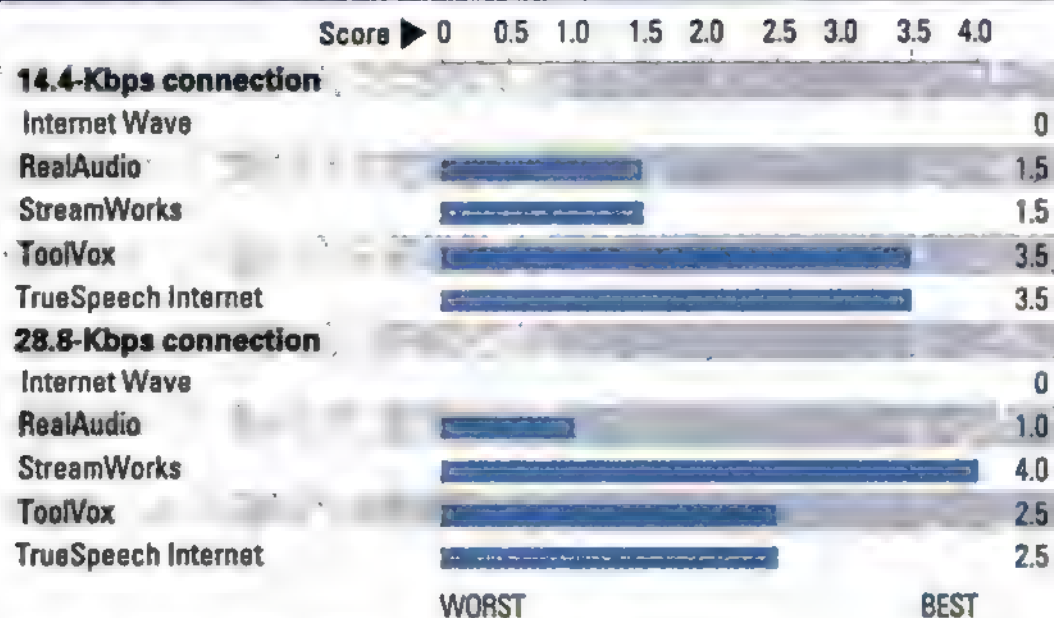
Fortunately, new streaming (continuous-delivery) audio technologies can provide the instant aural gratification most surfers expect. Streaming technologies start playback after a short buffering period and continue to play until the message is finished. Some provide VCR-style features such as seek, fast-forward, and rewind. Much more responsive than older download-and-play technologies, streaming technologies give end users a sense of immediacy and offer Web authors a powerful hook for attracting and keeping an audience that's always just a click away from the next person's site.

Here we look at the five important streaming audio products on today's Web: Internet Wave 1.0, from VocalTec; RealAudio 2.0, from Progressive Networks; StreamWorks, from Xing Technology Corp.; ToolVox for the Web, from Voxware; and TrueSpeech Internet, from The DSP Group. While our tests showed that no single product is ideal in all situations, we found that Web-based audio is a viable reality.

Streaming audio technologies are designed to overcome the fundamental problem facing multimedia elements distributed over the Web: limited bandwidth. While your 28.8-Kbps modem or 128-Kbps ISDN connection may seem screamingly fast, it pales in comparison even to an ancient single-spin CD-ROM drive that can transfer 150K of data each second.

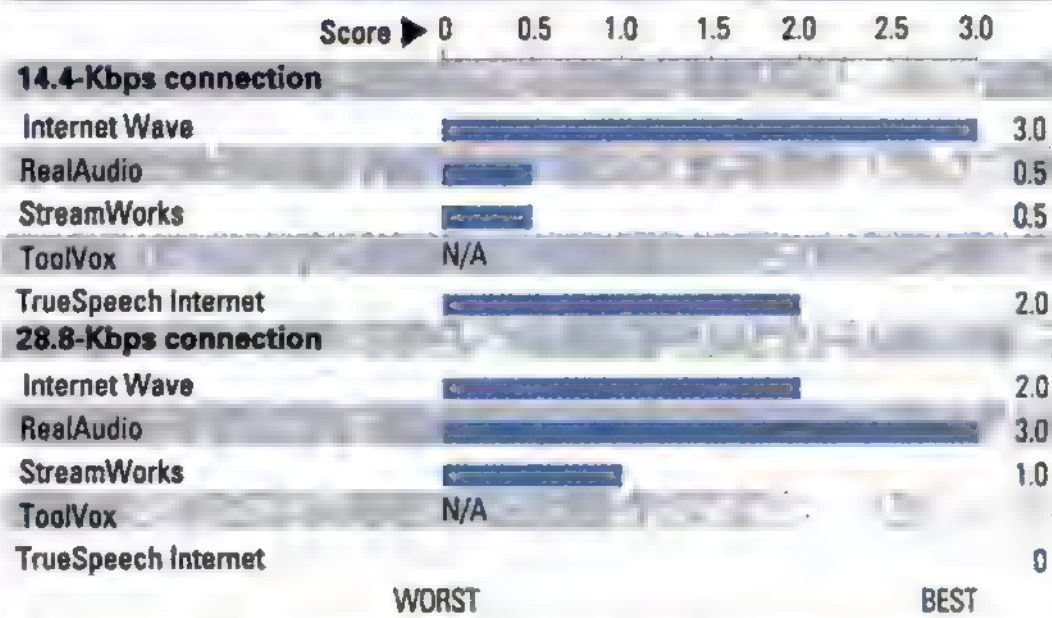
Where most of us think in bytes (or kilobytes) per second, the communications world has to think in bits, which come eight to a byte. Your 28.8-kilobit-per-second (28.8-Kbps) modem has a throughput capacity of about 3.6 kilobytes (3.6K) per second, approximately $\frac{1}{40}$ the speed of the single-spin CD-ROM drive you junked last year. CD-quality audio requires about 176K of raw data per second, close to 50 times the capacity of your 28.8-Kbps modem. For this reason, all streaming audio technologies compress the audio data stream drastically to match the

JURY RATINGS: SPEECH



The highest possible score is 4 points.

JURY RATINGS: MUSIC



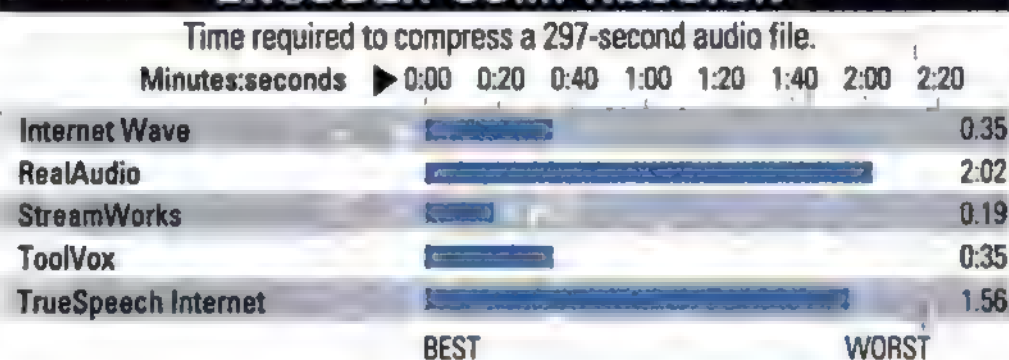
The highest possible score is 3 points. N/A—Not applicable: ToolVox is not intended for music compression.

throughput of your Internet connection, which may be as low as 9,600 bps.

TECHNOLOGY COMPONENTS

All streaming audio products are *codecs* (coder/decoders) with at least two components: the compressor (or encoder) that compresses the audio stream and the decompressor (or player) that decompresses and plays the compressed audio stream. A third component, offered by Progressive Networks and Xing Technology, is dedicated server software. It either delivers the audio streams to the clients or provides advanced functionality to the player, or both.

ENCODER COMPRESSION



Encoders tend to be standalone products charged with one simple task: shrinking the audio bitstream to match the capacity of the low-bandwidth connections we use for Internet access. All streaming products use *lossy* techniques achieve the high compression rates needed; this means that the original file is not reproduced exactly

during playback. Rather, during compression, the codec discards the original data, replacing it with a more compact representation. During playback, the codec reassembles the information into a file that approximates the basic structure of the original but isn't exactly the same.

All lossy compression technologies, whether for audio, still images, or video, share one characteristic: The more you squeeze, the more you distort. When comparing streaming audio encoders, one obvious measure is to see which technology produces the least distortion at a common compression ratio; that is, which technolo-

How We Tested Streaming Audio

We used jury tests to judge the playback quality of each product reviewed. To ensure impartial results, we did not let jury members know which decoder they were listening to. We chose two sound samples, a rock music selection and a speech sample, and encoded each for playback at both 14.4 Kbps and 28.8 Kbps. Each product was successively compared one-on-one against all the others, at both speeds. The testers judged clarity, accuracy of reproduction, and "listenability" (lack of irritating artifacts). Each product's result was a win, tie, or lose score (1, 0.5, or 0) in each contest. The final scores for each product are summarized in the accompanying graphs above. We played all samples from a local HP Vectra XU 5/90C with a Diamond TeleCommander

3500XL sound card and Advent Powered Partners AV622 speakers. The exception was Xing Technology's StreamWorks, which does not support playing local files. We piped the Xing samples from a local server to the HP workstation.

We tested the compression speed of each audio encoder by measuring the time needed to compress a 297-second WAV file of speech. Encoding was performed for 28.8-Kbps playback on a Gateway 2000 P5-133. Though we saw widely varying results, all encoders were able to compress faster than real time.

Our compatibility tests checked to see whether the player modules were compatible with five top browsers: CompuServe's Mosaic-based browser, Microsoft Internet Explorer 2.0, Net-

Manage WebSurfer 4.6, Netscape Navigator 2.0, and Quarterdeck's Qmosaic 2.0, and StreamWorks. We encountered no incompatibilities. We also informally tested five simultaneous connections to an external audio site to establish that each technology could handle a minimum of five streams.

Our playback clients were HP Vectra XU 5/90C's connected to a 10-Mbps Ethernet network through on-board PCI Ethernet adapters. Our test server was a Micron Pentium 133 with 64MB of RAM, running Netscape Communications Server 1.1 under Microsoft Windows NT Server 3.51. An exception was Xing's StreamWorks, which we tested using a Silicon Graphics Challenge S server.

— Analysis written by Jay Munro

gy sounds best during playback.

To test audio playback quality, we compressed two types of files, speech and music, for two target bandwidths, 14.4 and 28.8 Kbps. We then performed round-robin, blind-jury testing that pitted each technology directly against the others in each compression category. We learned that all technologies have strengths and weaknesses (see the graphs for scores).

All companies offer free encoders on at least one platform. While all systems can compress faster than real time, not all have the hooks necessary for live encoding. So if you're interested in live broadcasting, your choices are more limited. Xing Technology Corp. offered the first real-time audio compression system, but now Progressive Networks and The DSP Group offer or are planning similar options.

THE PLAYER END

Where encoders function on their own, players necessarily must work with various browsers and Web servers to integrate streaming audio playback into the fabric of the Web. Players are most commonly integrated into your browser as *helper* applications. Like other helpers, players are registered with the browser and are loaded when the browser detects an incoming audio file in the appropriate format. Once loaded, the player functions as a standalone program. Each player offers the user a range of features, which may include volume control, fast-forward, stop, and resume.

Thankfully, browser compatibility was not a problem. We tested each player with five Windows-based browsers: CompuServe's Mosaic-based browser, Microsoft Internet Explorer 2.0, NetManage Web-Surfer 4.6, Netscape Navigator 2.0, and Quarterdeck's Qmosaic 2.0. All players passed with flying colors.

With Navigator 2.0, Netscape raised the bar on player integration. Netscape's new plug-in specification lets Web authors define precisely how audio playback and the associated player are employed within the Web page. For example, the author can

RealAudio TrueSpeech Internet

Multimedia on the Web can mean anything from a handful of simultaneous streams to real-time broadcasts reaching thousands. Our two Editors' Choice

selections show that excellent technology is available at both ends of the spectrum.

For single-point broadcast applications aimed at hundreds of users, Progressive Networks's RealAudio offers the best server-based audio delivery system we've seen to date. The technology is polished, the server (available for most major platforms) is full-featured, and the player is attractive and highly functional. The RealAudio codec shines in music applications, at higher-bandwidth modem connections. Its speech quality and lower-bandwidth music are somewhat disappointing, an area that could use some improvement.

The DSP Group's TrueSpeech In-

ternet is an excellent solution for small sites—and one that's totally free. The encoder is a licensed component of Windows 95's Sound Recorder, and its speech-tuned codec produces excellent results over lower-bandwidth connections. The simple TrueSpeech player is available for free download for a variety of Windows and Mac platforms. If you're just beginning to explore streaming audio, TrueSpeech is a great way to start.

Xing Technology Corp.'s StreamWorks deserves an honorable mention for its powerful server-based audio system with proven real-time propagation and broadcast capability. A technology-driven product, its accessibility and ease of use still have a ways to go.



start the audio playing when the page is opened or embed the player into the body of the page rather than launching it as a separate player. Most other browser vendors support the plug-in specification or will do so shortly.

All vendors in this roundup distribute their players at no charge to the user or developer, but they differ in the platforms supported. When selecting a technology, make sure that players exist for all relevant target platforms. Few companies pay homage to the Unix platform that spawned the Internet, and fewer still directly support the PowerMac platform.

DO YOU NEED A SERVER?

Choosing between a server-based and serverless technology is the first and most important decision facing anyone who

wants to integrate streaming audio into a Web site. This determines both the number of simultaneous clients a system can service and the features users will enjoy. Server software typically represents the most significant system cost as well.

Real-world testing on the Internet is an uncertain and unwieldy task. Available bandwidth, connection overhead, and routing to remote servers fluctuate widely and unpredictably. Nonetheless, our tests indicate that most reasonably powered Web servers can distribute at least five simultaneous audio streams without audio server software. This should satisfy the needs of many smaller sites.

At the other end of the spectrum, developers who need to support dozens of simultaneous streams should assume that audio server software is required and start their search with Progressive Networks and Xing Technology. The server platform is also a key issue. While both companies support a wide range of Unix platforms, Progressive also supports Macintosh System 7.5 and Microsoft Windows NT. Xing promises

Our Contributors: JAN OZER is the president of Doceo Publishing, a developer of digital-video testing tools in Norcross, Georgia. He is also the author of *Video Compression for Multimedia*, and a frequent contributor to *PC Magazine*. RICK AYRE is an executive editor and CADE METZ is a staff editor of *PC Magazine*. THOMAS MACE was the senior editor in charge of this story, and JAY MUNRO was the project leader.

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Hard Drive	630MB or 1GB	630MB or 1GB	630MB or 1GB	1GB
Cache Internal	16KB	16KB	16KB	16KB
Cache External	256KB (optional)	256KB (optional)	256KB	256KB
Architecture	PCI	PCI	TriFlex/PCI	TriFlex/PCI
Video Memory/Max.	1MB/2MB	1MB/2MB	1MB/2MB	1MB/2MB
Compaq 150 Color Monitor	Yes	Yes	Yes	Yes
Diskette Drive	3.5" 1.44MB	3.5" 1.44MB	3.5" 1.44MB	3.5" 1.44MB
Expansion Slots (Total)	3	3	4	5
Drive Bays (Total)	3	3	4	5
Ports: Serial/Parallel	1/1 (ECP)	1/1 (ECP)	1/1 (ECP)	1/1 (ECP)
Security Features	Yes	Yes	Yes	Yes
Processor Upgradable	Yes	Yes	Yes	Yes
101-Key Keyboard, Mouse	Yes	Yes	Yes	Yes
Software Preinstalled (Choice of)	MS-Windows® 95 or MS-Windows 3.1	MS-Windows 95 or MS-Windows 3.1	MS-Windows 95 or MS-Windows 3.1	MS-Windows 95 or MS-Windows 3.1
Energy Star Compliant	Yes	Yes	Yes	Yes
Limited Warranty*	3-Year	3-Year	3-Year	3-Year
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Windows NT support by the first quarter of 1996.

End-user features are another reason to look to a server-based system, especially when using long audio files. Server software is required to support the player's ability to scan or fast-forward, something users will find extremely convenient if your files exceed a minute in length. VocalTec's server software provides this feature for the limited number of platforms that it serves; so can both Progressive Networks' and Xing's.

PROTOCOL ISSUES: UDP VS. TCP

One potential downside of the Progressive Network and Xing servers is the UDP (User Datagram Protocol) they both use to transport the audio streams over the Internet. VocalTec, Voxware, and The DSP Group use TCP (Transmission Control Protocol).

UDP is a bandwidth-oriented streaming protocol without error correction. While it is the most efficient mechanism for broadcasting multiple streams of information, lost packets can and do occur. By contrast, TCP is an error-correcting protocol that guarantees in-order packet delivery. Error correction requires additional server overhead and bandwidth, however, as does the redelivery of lost or scrambled packets.

We experienced minimal audio loss associated with lost packets. But UDP creates another potentially more serious issue relating to corporate firewalls. Where internal firewalls automatically pass through TCP-transported information, some choke on information transported by UDP. It's not a security issue, but it may affect your ability to retrieve RealAudio or StreamWorks packets from a server located outside the firewall. Both Progressive Networks and Xing acknowledge the problem. Progressive Networks is working with firewall vendors to gain RealAudio-specific support and may release a server with TCP transport capability by the time this story appears. Xing is dealing with the issue on a case-by-case basis. The use of UDP can also raise Internet bandwidth saturation issues (for details, see "Audio on the Web," *PC Magazine*, March 12, 1996).

Adding sound to your Web site takes some homework, but it's well worth the effort. The reviews that follow will help you decide which products offer you the best fit.

VocalTec Inc.

Internet Wave

ALL REVIEWS BY JAN OZER

With the introduction of its Internet Phone—a product that supports full-duplex voice conversations over the Internet—VocalTec made its reputation as one of the pioneers of Internet audio. Building on this technology, VocalTec has since introduced its free Internet Wave (IWave) which provides high-quality, low-bandwidth music compression and an engaging player. IWave's compressed speech is slightly disappointing—a surprise given its origins—and its server functionality is minimal. But among the sites distributing low-bandwidth music in limited quantities, IWave may be the best choice.

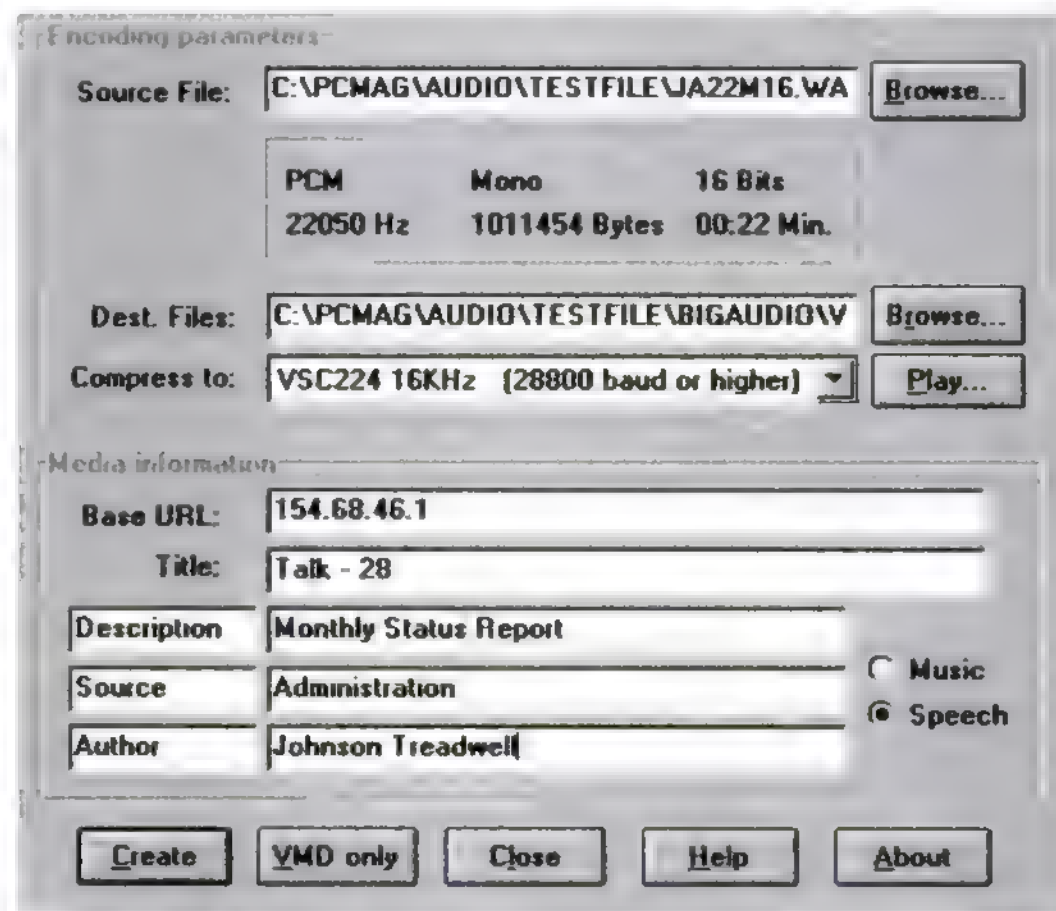
IWave has three components: an encoder, a player, and a simple server utility that lets you fast-forward through audio files (the server utility is not required to achieve streaming functionality). Each component is available for free download at VocalTec's Web site. The encoder and the server are bundled together, but you can obtain the player only as part of the demo version of Internet Phone. Both the player and encoder are Windows 3.x applications that also run under Windows 95 and Windows NT.

THE ENCODER

The IWave encoder is well laid out and feature-rich. It offers four different compression bandwidth options (one each for 9,600 bps and 14,400 bps and two for 28,800 bps). IWave also features presets for music and speech that allow you to customize the compression of audio content. You can input both the URL information used to integrate the file into the Web site and an audio clip's title, description, and other information for display during playback.

With comprehensive help files and documentation, VocalTec does a good job of educating the user about fundamental audio recording, editing, and compression procedures. The encoder itself even provides assistance as you work: It checks your audio input parameters before compression and warns you if they don't match the recommended settings.

During our testing, the IWave en-



IWave's encoder delivered mixed compression quality with the best results we saw for music—and some of the worst for speech.

coder was both stable and fast. It compressed our 297-second test file in just under 35 seconds.

The quality of compression under IWave was mixed. Both low- and high-bandwidth speech files sounded muffled and distorted, as if they had been recorded in a tunnel. Compression at 14.4 Kbps even introduced a noticeable lisp. As a result, IWave was the only technology that did not win a single contest in our speech compression tests. With music compression, however, the situation was reversed. IWave finished first in the low-bandwidth testing and came in second in the 28.8-Kbps tests. IWave's 14.4-Kbps music stream was clear and managed to preserve the individual sounds of each instrument to a much greater degree than the other products here.

SERVER INTEGRATION

During compression, the IWave encoder automatically produces two files: one with a .VMF extension that contains the com-

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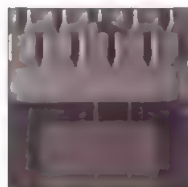
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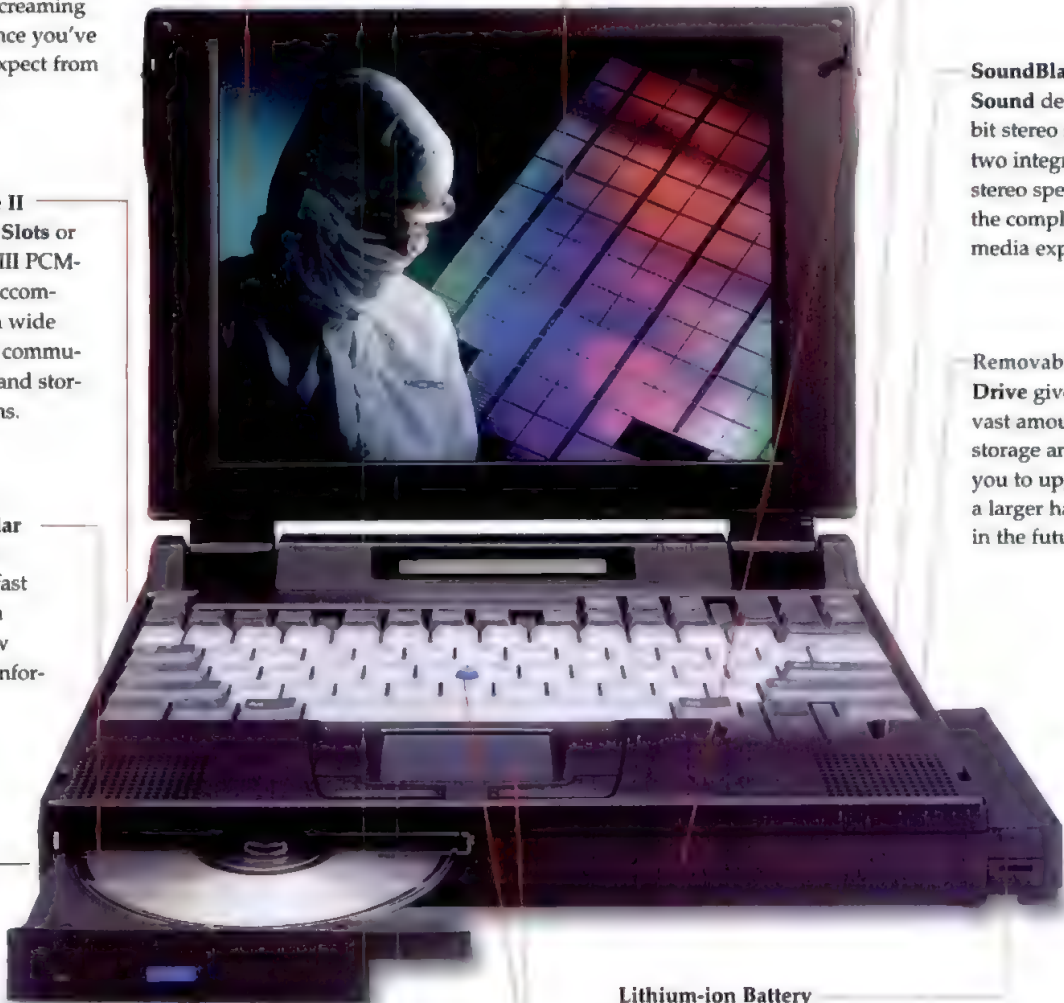


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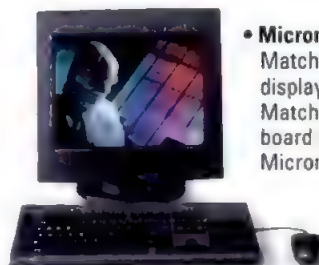
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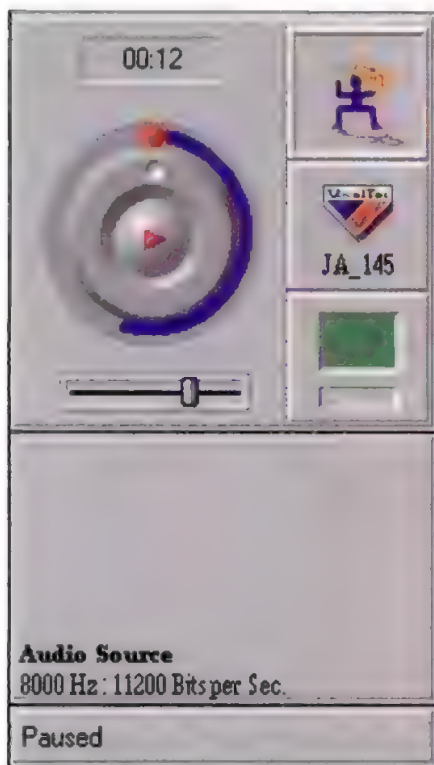
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pressed audio, and the other, a simple text pointer file with a .VMD extension containing file description and location data. Both extensions must be registered as MIME (Multipurpose Internet Mail Extensions) types on your Web server. The .VMD extension is tagged in your HTML page to trigger file retrieval.

VocalTec also provides a server utility that enables fast-forwarding through an audio file. This utility is available only for Solaris 2.4 and SunOS 4.x, and we did not test it.



The IWave player offers a nice collection of controls and a boom box-toting status icon.

THE PLAYER

To obtain the IWave player, you'll have to download the demo version of VocalTec's Internet Phone—a 1.3MB self-extracting zip file that delivers program components for installation via the Start/Run command. Like the IWave encoder, this package is a Windows 3.x application that also runs under Windows 95 and Windows NT. As we went to press, VocalTec announced a Macintosh version of IWave and Internet Phone, filling an important gap in its product line.

To illustrate an audio file's playback status graphically, the player displays an animated figure with a boom box. When file starts to upload, the figure plugs the boom box into an outlet; then while audio plays, the figure happily dances around. When a buffer underrun stops the audio, the figure jumps on the boom box and leaps up and down. This may not impress your buttoned-down boss, but it's wonderfully appropriate for the myriad Generation Xers prowling the Internet.

The IWave player has a suitable assortment of features: volume control, status bar, and digital readout of playback time, as well as stop and resume buttons.

not register until we had installed it three or four times. Under both Windows 95 and Windows 3.1x, the player often failed to load and spawned an error message that read "Internet Wave requires Internet Phone installed on your computer in order to run." Of course, Internet Phone was already installed, and we often had to run Internet Phone to run the player.

These problems notwithstanding, IWave's music quality makes it well worth considering for every music-oriented Web site that does not require advanced server functionality.

Internet Wave. List price: Free. VocalTec Inc., Northvale, NJ; 201-768-9400; fax, 201-768-8893; <http://www.vocaltec.com>. Circle 441 on reader service card.

You also have the option of displaying an audio file's author, description, and source (each of which must be input during the compression stage). Other advanced controls allow you to change the download cache size, modify the pre-play buffering time, and adjust the amount of downloaded audio stored to disk.

Although this player was compatible with all of the Web browsers used in our testing, it did not automatically register as a helper under Netscape during installation, and the IWave .VMD extension did

Progressive Networks Inc.

RealAudio



While other products in this evaluation concentrate on the quality of compressed audio and leave delivery to the Web server, Progressive Networks offers a complete Internet audio delivery system backed by an audio codec that shines in high-bandwidth music applications. If you're building a low-traffic audio site, you don't need all the features that the RealAudio system offers. But if you're interested in broadcasting to hundreds of users, it should definitely be on your short list.

RealAudio Server is priced according to the number of simultaneous streams it supports. Prices range from \$2,490 for ten simultaneous streams to \$13,490 for 100, including support and upgrades for a year (base prices range from \$1,495 to \$9,995). You can obtain a free RealAudio Player from the Progressive Networks Web site or from the site of one of the myriad RealAudio customers. We tested the beta release of RealAudio, Version 2.0.

THE ENCODER

RealAudio Encoder comes in a self-extracting 323K file that unzips into an .EXE and various support files. This full-screen application is divided into halves. The left-hand side shows your file input, which can be .AU, .RA, or .WAV files or real-time audio for broadcast applica-



The RealAudio encoder offers a sophisticated interface and the ability to send a live stream to the RealAudio server.

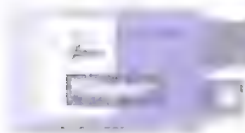


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tions. The right-hand side displays your output, which can be a compressed file or a live stream to RealAudio Server.

There are two RealAudio compressed file outputs: 14.4 Kbps and 28.8 Kbps. The program lets you input title, author, and copyright information, which is then embedded in the file header and can be read back by RealAudio Player. To assist you in monitoring broadcast audio, the encoder includes an option that allows you to listen to either the original file or the compressed RealAudio file during compression.

Progressive Networks does a very thorough job of documenting its recording and compression process through help and README files, manuals, and white papers on its Web site. The encoder itself is stable and functional; it compressed all of our test files without incident.

Compression results were mixed, however. RealAudio fared poorly on our speech tests, with its 14.4-Kbps stream exhibiting slurring and a slight echo. The 28.8-Kbps speech stream was much clearer, but it still failed to match the high-bandwidth audio of StreamWorks, ToolVox, and TrueSpeech.

On the other hand, RealAudio won the high-bandwidth music tests outright, producing clear, distinct audio (though not quite up to the FM quality touted in the documentation). Lower-bandwidth music was fuzzy and muddled, putting RealAudio in a tie for second place in that category.

THE SERVER

RealAudio Server, which delivers your compressed audio, is available for Macintosh, Unix, and Windows NT platforms and is compatible with a number of other server technologies. We installed the Windows NT version on a Netscape Communications Server.

Installation involves three simple steps. First, we configured the server for PNA Protocol Port, maximum audio connections, and connection time-out. Then, we registered the RealAudio format as a MIME type in Netscape. Finally, we installed the server as a service under Windows NT.

RealAudio Server uses the User Datagram Protocol (UDP), a non-error-correcting protocol, as the



*RealAudio fared poorly
on our speech tests,
exhibiting slurring and
a slight echo. But it won
the high-bandwidth
music tests outright.*

transport mechanism for its audio packets. In testing with busy real-world sites, there were few packets lost.

Standard server features include remote monitoring and a graphical usage display. Version 2.0 adds several features: a new splitter technology that lets remote RealAudio servers rebroadcast Real-

Audio files to multiple sites, bandwidth negotiation that allows a server to query a RealAudio Player and automatically select the proper bandwidth to transmit, and an API that allows other compression technologies to work within the RealAudio delivery architecture.

Integrating RealAudio playback into a Web site requires a text file with a .RAM extension that contains the name and location of the actual RealAudio file. When the user clicks on the tag, the RealAudio server contacts a RealAudio player and gives it the file location. The player then retrieves the file and starts to play it.

RealAudio may be incompatible with some internal firewalls, but Progressive Networks is working with vendors to resolve this problem. It will also release a new RealAudio server with TCP transmission capabilities in the first quarter of 1996.

THE PLAYER

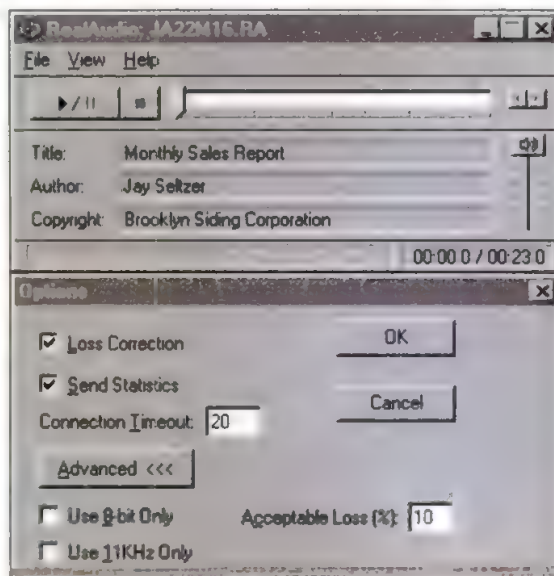
RealAudio Player is available in Macintosh, Unix, Windows 95, Windows 3.x, and Windows NT versions. We tested the Windows 95 version, a 656K self-installing executable available as a plug-in for Netscape 2.0 or as a helper application for other browsers.

This player includes a status bar that can be dragged to random point in the file, a timer, volume control, and the ability to pause and resume your audio clips.

In appearance, it is conservative and businesslike. You can minimize the player to its start and stop buttons, or expand it to a full window that displays connection statistics and audio file information.

Although RealAudio shines in delivering music at a 28.8-Kbps connection speed, the quality of its speech compression leaves something to be desired. Even so, its polished and widely adopted server technology is your best current option for broadcasting large numbers of simultaneous streams.

RealAudio. List price: Server: 10 streams, \$2,490; 100 streams, \$13,490; Encoder and player, free. Progressive Networks Inc., Seattle, WA; 206-447-0567; fax, 206-223-8221; <http://www.realaudio.com>. Circle 442 on reader service card.



A slick app that supports random access, the RealAudio player is available as a Netscape plug-in or a helper app.

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Xing Technology Corp.

StreamWorks

Although it is expensive and not particularly well documented, Xing Technology Corp.'s StreamWorks audio technology is extremely powerful and effective once you get it running. For a small site that needs to support two or three simultaneous audio streams, this high-end multimedia system is clearly overkill. But its unique blend of extensibility and scalability make it a good fit for broadcasters serving hundreds of simultaneous clients or for Web sites serving clients with varying bandwidth connections.

StreamWorks is a server-based technology whose price depends on your server connection bandwidth. Prices range from \$3,500 for a 1.5-Mbps connection to \$50,000 for a 1,600-Mbps connection. Xing offers two encoder options: a \$2,500 hardware encoder that handles real-time audio, and a free software encoder for non-real-time systems. The video hardware encoder is reviewed in our roundup of Web video products in this story.

COMPRESSION

The StreamWorks software encoder is a DOS command-line program that converts .WAV files to Xing's proprietary LBR (low bit rate) format. Its only compression parameter is a compressed-file bit rate, which ranges in size from 8 to 16 Kbps. While not elegant, the program is fast and stable.

The only significant downside of this system is that the StreamWorks client can't play local files from a disk; it can only play streaming files from the Web server. Since Xing does not offer a Windows-based server, you have to upload files to the Web server to test them, a significant hassle. Xing plans to ship a Windows-based compressor/player during the first quarter of 1996.

Like all of the technologies in this evaluation, the software encoder produced mixed results in our testing. Although it scored poorly on our low-bandwidth speech and music tests, the software encoder topped the charts on our 28.8-Kbps speech tests. Its crisp, clear audio stream at high bandwidths was virtually indistinguishable from our original test file.

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The StreamWorks player can handle both audio and video streams. You can preconfigure additional buttons for favorite servers.

The StreamWorks hardware compressor (tested for our video review) produces higher-bit-rate and higher-quality MPEG-1 and MPEG-2 audio files as well as LBR files. Unlike other streaming audio technologies that are hard-coded to a maximum 28.8-Kbps output, this encoder can tailor its output for higher bandwidths such as single- or dual-wire ISDN (64 and 128 Kbps). This feature is key to StreamWorks' strategy. Since we're dealing with lossy compression technologies, bumping the data rate where bandwidth permits also boosts audio quality.

Still, the competitive advantage of real-time encoding provided by this hardware system is eroding. Progressive Networks provides free, software-based real-time encoding in Version 2.0 of the RealAudio encoder, and The DSP Group intends to provide real-time TrueSpeech encoding software at a nominal charge sometime during the first half of 1996.

SERVER INTEGRATION

We tested the StreamWorks server on a Silicon Graphics WebForce Challenge running SGI IRIX. Instead of supplying documentation, Xing advises users to call tech support for registration information and simple installation instructions. After a brief phone call, we configured the server, registered the MIME type, and had the server running in a matter of minutes.

Like RealAudio, Xing's server strategy is primarily based upon extensibility. Though Progressive Networks's plans are not yet realized, Xing's Reflecting Server

technology has been operational for months. In essence, the Reflecting Servers act as remote StreamWorks servers that input an audio stream (or audio/video stream) and rebroadcast that stream to multiple clients. This allows the content originator to support many more clients than his own Internet connection would otherwise allow.

StreamWorks uses UDP as opposed to TCP, opting for broadcast efficiency at the risk of quality degradation. To avoid firewall incompatibilities, Xing provides a patch to system administrators. It routes StreamWorks packets around the firewall while maintaining firewall integrity.

THE CLIENT

The StreamWorks Client, available for Mac OS, Unix, and Windows 3.x, (Windows 95 and Windows NT-compatible), offers two different modes for file access: direct-connect mode and watcher mode. The former directly queries a database that resides on a StreamWorks server and plays back a particular file. The latter, which runs as a helper application on your browser, reads a small text file with an .XDM extension that is embedded in a Web page. This XDM file then calls the client with the file URL. The client calls the server to start the streaming process.

In direct-connect mode, you can surf from server to server by clicking through your own set of preconfigured buttons—much like channel surfing with a television remote control. You also get volume control and buffer controls. In watcher mode, you can configure the client's appearance and functionality. Your choices include volume control and the ability to seek random locations but not to stop and resume. At press time, Xing was also offering a beta version of its client that has Netscape 2.0 plug-in capabilities.

StreamWorks is a technically sound,

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 **HEWLETT
PACKARD**

industrial-strength product, although it remains sorely underdocumented. Xing will most likely solve this problem soon. Web authors seeking heavy-duty broadcasting functionality will find StreamWorks' performance more than adequate compensation for the hoops they have to jump through to get the system running. **StreamWorks.** List price: Server: 1.5 Mbps connection, \$3,500; 1,600-Mbps connection, \$50,000. Encoder and player, free. Xing Technology Corp., Arroyo Grande, CA; 805-473-0145; fax, 805-473-0147; <http://www.xingtech.com>. *Circle 443 on reader service card.*

Voxware Inc.

ToolVox for the Web

As long as you're working solely with speech, Voxware's ToolVox for the Web provides remarkable low-bandwidth audio. This free package tied for first place in our 14.4-Kbps speech testing, even though it used only 30 percent of its closest competitor's bandwidth. Unfortunately, ToolVox's voice-oriented MetaVoice compression algorithm is totally unsuited for music and lacks the support of both a full-featured player and advanced server functionality. But those Web authors who want to add low-bandwidth speech to their Web pages will be

Modeling quality and bandwidth are extremely efficient. ToolVox tied for top honors with The DSP Group's TrueSpeech in our 14.4-Kbps speech testing, but TrueSpeech's file was 317K, whereas ToolVox's was a mere 89K. Modeling also enables the manipulation of playback speed, including speeding up and slowing down, without distortion or changes in tone.

MetaVoice is so tuned to speech that ToolVox's help file warns, "Do not attempt to compress waveform data that contains musical instruments, sound effects, or more than one voice speaking or singing simultaneously." For the sake of completeness, we started to test ToolVox with our music test file, but the results were so poor that we simply dropped ToolVox from our music competition.

ToolVox has two components: WebEncoder and WebPlayer. Since Voxware does not offer a server component, ToolVox files must be embedded in your Web site with standard HTML references.

WEBENCODER

At the time of our testing, WebEncoder was available only for Windows 95, but Voxware intends to offer versions for both Macintosh and Windows 3.x. Its

downloadable 1,192K file is a self-installing executable; no unzipping is required. Once installed, WebEncoder accepts AIFF and .WAV files in all parameters but resamples files down to 8 kHz prior to compression. All input files are compressed to 2,400 bps, and

there are no variable bandwidth controls or presets.

Even at this low bandwidth, ToolVox's audio quality was still sufficient to tie for first place with TrueSpeech on our 14.4-Kbps tests. When compared with the original uncompressed audio file, ToolVox's compressed file was clear and without noticeable slurring or breakup. The only obvious difference from the original sound



WebPlayer worked smoothly, but its garish interface and limited functionality won't win any contests.

was a slight tinniness and a faint echoing that were reminiscent of a long-distance telephone call.

WebEncoder's inability to scale up to higher bandwidths does limit its functionality, as is evidenced by the drop in its relative score in our 28.8-Kbps speech competition. But using close to seven times the bandwidth of the ToolVox files, only Streamworks was able to exceed ToolVox's quality.

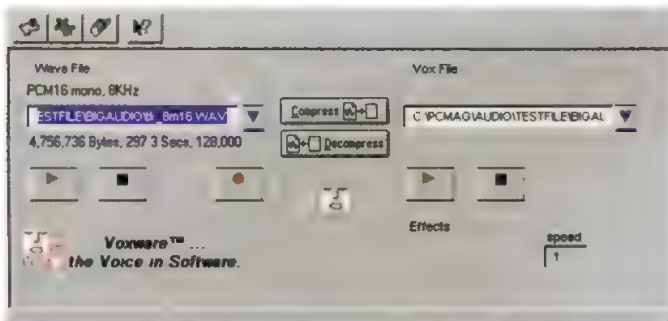
The compression process was relatively straightforward, although WebEncoder occasionally misplaced our .WAV files after we had loaded them; in some cases we had to input files two or three times before finally compressing them. Compression time was extremely fast—35 seconds for our 297-second test file—but ToolVox does not offer real-time compression for simulcasting over the Web.

WebEncoder also functions as both an audio recorder and a player for .WAV and VOX files. The latter function lets you test a compressed file without loading WebPlayer, a useful feature. Online help is also comprehensive and useful, covering such topics as HTML codes for embedding VOX files in pages and Netscape 2.0 Plug-In operating parameters.

WEBPLAYER

WebPlayer is available as a self-running installation program roughly 600K in size. The only platform available for our testing was Windows 95, although Voxware plans to ship Windows 3.x and Macintosh System 7 players in 68K and PowerMac versions.

WebPlayer is available both as a plug-in for Netscape 2.0 and as a helper application for Netscape 1.x and other browsers. Since it's a non-server-based system, WebPlayer doesn't let you scan through an audio file or stop and resume



ToolVox's WebEncoder compresses voice files to where they will stream over a slow 2,400-bps connection. Quality stays remarkably high.

hard-pressed to find a better solution.

Voxware's entire product line centers on its MetaVoice compression algorithm. Unlike most traditional audio compression technologies, which compress by averaging data elements and eliminating redundancies, MetaVoice meticulously analyzes digitized audio and creates a mathematical model of an individual's speech characteristics.

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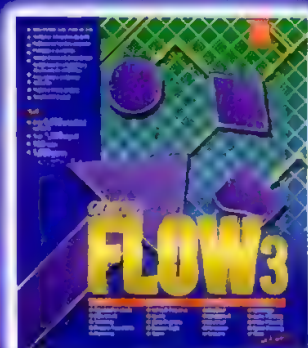
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in the middle of a playback. This drawback is somewhat mitigated by its ability to fast-forward through an audio file to the relevant start points.

WebPlayer's neon interface is somewhat garish. It has a faux LCD readout of filenames and elapsed time, stop and start controls, and a slider bar for fast-forwarding. Although it does include a volume gauge, there is no volume control or progress bar. WebPlayer's odd appearance and lack of functionality are disconcerting when you are playing long audio clips or require extensive interaction with your audio.

WebPlayer ran through our compatibility tests smoothly, loading correctly in all test environments. It also handled our real-world connection tests without a hitch.

Both ToolVox components are free, though Voxware intends to ship gold versions of the encoder by mid-1996 that provides slightly higher audio quality at the same bandwidth. Though prices have not yet been determined, the gold versions will probably cost less than \$100.

Overall, ToolVox is something of a one-trick pony, providing no-frills, low-bandwidth speech compression and playback. It may, however, be the horse to ride if you don't require music compression.

ToolVox for the Web. List price: Free. Voxware Inc., Skillman, NJ; 609-497-1212; fax, 609-497-2490; <http://www.voxware.com>. Circle 445 on reader service card.

The DSP Group Inc.

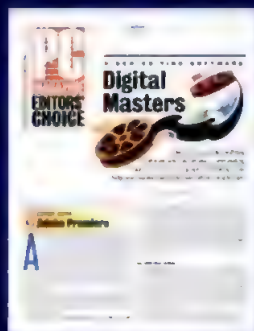
TrueSpeech Internet



Unlike other speech-specific products, The DSP Group's TrueSpeech Internet provides excellent low-bandwidth quality for music as well as speech. It lacks advanced broadcasting capabilities and simple player functions such as stop and resume, but its player is free, and its compression/decompression technology is included with Microsoft Windows 95. If you want to offer multiple types of low-bandwidth audio, TrueSpeech is a good choice.

TrueSpeech is a compression technology that is used in a diverse range of products, including digital answering

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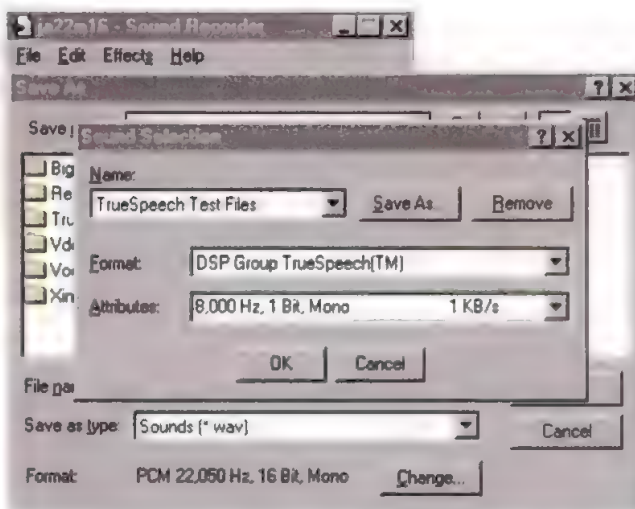


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INTERNET

Web-Based Audio



The TrueSpeech encoder, licensed from The DSP Group, is integrated into the Microsoft Windows 95 Sound Recorder.

machines, telephones, and dual simultaneous voice and data modems. In addition to offering software and chip-based implementations, The DSP Group also provides a wide range of compression algorithms; each trades a different amount of compression and playback complexity for compression ratios and audio quality.

In 1994, The DSP Group licensed the TrueSpeech 8.5 algorithm to Microsoft for inclusion in Windows 95. This version provides 15:1 compression—which reduces an 8-MHz 16-bit audio stream to roughly 8.5 Kbps—and real-time playback on 486/33 and faster computers. This past August, The DSP Group announced TrueSpeech Internet, which is also built around TrueSpeech 8.5.

Like Voxware's ToolVox for the Web, TrueSpeech Internet is optimized for the spoken word and uses sophisticated modeling techniques to achieve relatively high compression and high-quality playback. While TrueSpeech can't touch ToolVox's low-bandwidth performance, it matches ToolVox in speech quality while providing adequate music compression as well. This makes TrueSpeech much more suited for general-purpose audio sites or sites that use

speech with background music.

The TrueSpeech Internet Player, available on The DSP Group's Web site, is required to play back streaming audio. Although the compressor is available only for Windows, the player has both Windows and Macintosh versions. The DSP Group is considering the development of server software that will enable real-time compression, but a release date and pricing

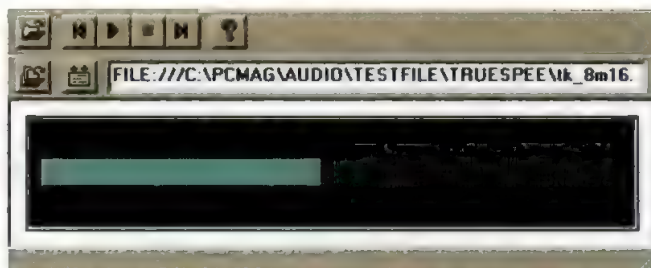
had not been determined at press time.

FILE COMPRESSION

We tested TrueSpeech under Windows 95, using that operating system's Sound Recorder component to compress the audio. The Sound Recorder is reasonably well featured: It provides both recording and compression functions. But it lacks TrueSpeech-specific documentation. The only help available for either encoding or playing back TrueSpeech files was from the README file that comes with the TrueSpeech player.

Following the recommendations in the README file, we tested with 80-kHz 16-bit .WAV files. We compressed these files in the Sound Recorder by changing the file format to TrueSpeech and saving the result. A TrueSpeech-encoded file automatically loads into the Sound Recorder after completion, which lets you test compression results immediately.

TrueSpeech does not use presets or compression controls; all files are simply



The TrueSpeech Internet Player is austere in both function and appearance. A Netscape plug-in is on the way.

compressed to approximately 8.5 Kbps. On our 133-MHz Pentium test system, TrueSpeech operated faster than real time, compressing the 297-second test file in under 120 seconds.

On our 14.4-Kbps speech compression tests, TrueSpeech tied for first place with ToolVox. It produced extremely clear audio, contained no echo or tinniness, and had just a hint of slurring. Although it is a voice-tuned compression algorithm, TrueSpeech also performed a bit better than most other algorithms on our low-bandwidth music tests. TrueSpeech's single-bandwidth algorithm fared less well on our 28.8-Kbps tests; it took second place to Streamworks in speech and finished in last place on our high-bandwidth music tests.

Since TrueSpeech files use the standard .WAV extension, The DSP Group created the .TSP extension to incorporate TrueSpeech files into Web pages. Rather than pointing directly to the .WAV file in an HTML description, you must point to a .TSP file, which in turn points to a TrueSpeech .WAV file. The .TSP alias is registered on Web servers as a standard MIME type.

THE PLAYER

The TrueSpeech Internet Player's 282K downloadable file contains a self-running executable that unzips its various setup files. The program is austere in both function and appearance. As a serverless technology, TrueSpeech doesn't offer stop-and-resume or random access to the audio stream. Nor does it offer a volume control.

On the plus side, TrueSpeech lets you adjust the initial download buffer size to decrease the latency associated with buffering. The player also lets you store bookmarks, which may be useful when playing compressed audio files outside your browser environment. The version we tested integrates into browsers only as a helper application, but The DSP Group was working on a Netscape 2.0 plug-in player at press time.

Whereas other streaming audio compression technologies require specialized players, TrueSpeech files are compatible with standard programs like Media Player. This will become increasingly important as developers publish

SUMMARY OF FEATURES

Web-Based Streaming Audio Products

	Internet Wave 1.0	RealAudio 2.0	StreamWorks	ToolVox for the Web	TrueSpeech
PC MAGAZINE EDITORS' CHOICE PC MAGAZINE EDITORS' CHOICE					
■ YES □ NO					
Products listed in alphabetical order					
Server					
Price of server software	N/A	Varies by number of supported streams	Varies by supported bandwidth	N/A	N/A
HPUX/LINUX/BSOI	N/A	■ ■ ■	■ ■ ■	N/A	N/A
Macintosh, OS/2	N/A	■ ■	■ ■	N/A	N/A
SGI/Sun Solaris/SunOS 4.x	N/A	■ ■ ■	■ ■ ■	N/A	N/A
Windows NT	N/A	■	■ ¹	N/A	N/A
Remote monitoring	N/A	■	■	N/A	N/A
Transmission protocol	TCP	UDP	UDP	TCP	TCP
Multipoint broadcasting	■	■ ¹	■	■	■
Encoder					
Price	Free	Free	Free	Free	Free
Windows 95 native	■	■	■	■	■
Windows 3.x native	■	■	■	■ ¹	■
DOS native	■	■	■	■	■
OS/2 native	■	■	■	■	■
Real-time encoding	■	■	Optional (\$2,500) ²	■	■
Input file formats	AU, .WAV	AIFF, AU, .WAV	WAV, recorded or live stream	AIFF, .WAV	WAV
Bandwidth presets	5.5, 8.0, 11.0, 16.0 Kbps	8.0, 15.0 Kbps	8.0 to 16.0 Kbps (scalable)	2.4 Kbps	8.5 Kbps
Batch capabilities available	■	■	■	■	■
Integrated recorder	■	■	■	■	■
Player					
Price	Free	Free	Free	Free	Free
Windows 95/3.x/NT native	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■ ¹	■ ■ ■
OS/2 native	■	■	■	■	■
Unix/Macintosh native	■ ■	■ ■	■ ■	■ ■ ¹	■ ■
Available as standalone	■	■	■	■	■
Available as helper application	■	■	■	■	■
Available as Netscape 2.0 plug-in	■	■	■	■	■ ¹
Minimum suggested connection speed (bits per second)	9,600	21,600	9,600	9,600	14,400
Decoder download size	1.3MB	0.7MB	0.5MB	0.6MB	0.6MB
Integrated status bar	■	■	■	■	■
Timer display	■	■	■	■	■
Can start at random points	■	■	■	■	■
Can stop and resume	■	■	■	■	■
Volume control	■	■	■	■	■
Rewind	■	■	■	■	■
Fast-forward	■	■	■	■	■
Tunable buffer size	■	■	■	■	■
Local online help	■	■	■	■	■
Player does not expire	■	■	■	■	■

N/A—Not applicable: The product does not require server software.

¹ This feature is slated for the product's final release but was not available in the downloadable version we tested.

² A separate encoding hardware system is required.

simultaneously on CD-ROM and the Web. Developers can also access TrueSpeech compression from standard audio and video editing packages, making the algorithm much easier to work with.

Overall, TrueSpeech is an excellent choice for Web authors seeking simple, high-quality playback for audiences with 14.4-Kbps modems. Developers who re-

quire higher-level server functionality or wish to target high-bandwidth customers will be better served by other technologies.

TrueSpeech Internet. List price: Player, free. Encoder, included with Microsoft Windows 95; The DSP Group Inc., Santa Clara, CA; 408-986-4300; fax, 408-986-4490; <http://www.dspg.com>. Circle 444 on reader service card.



If video on the Web gives you a nagging sense of déjà vu, don't be surprised. Our review of the two leading Web-based streaming video products, StreamWorks from Xing Technology Corp. and VDOLive from VDO.net, shows video codec developers once again offering grainy, highly distorted low-resolution video. But this time, the video barely plays at 1 or 2 frames per second on a 28.8-kilobit-per-second (28.8-Kbps) connection.

While our review of streaming audio technologies found them quite usable across a wide range of bandwidths, our findings on streaming video products were less encouraging. As an end user, you'll find Web-based video an interesting experiment that's not yet ready for prime time, except over the fastest Internet connections. As a developer, you'll find it an uphill battle.

CHALLENGING PROBLEMS

It's not that streaming audio technologies are more advanced; if anything, the reverse is true. It's just that streaming video codecs have a much more difficult task. Compressing CD-quality audio (which is designed for a bandwidth of 176 kilobytes per second) to where it will work over a 14.4-kilobits-per-second connection requires an effective compression ratio of approximately 97:1. Several audio codecs start with lower-quality, 8-kHz, 16-bit audio, which requires only about 8:1 compression to reach the 14.4-Kbps bandwidth.

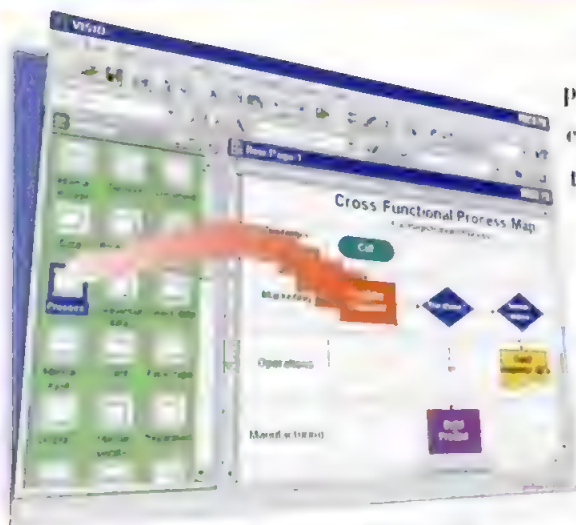
By contrast, compressing television-quality video, whose original bandwidth is about 27 megabytes per second, to a usable 28.8 Kbps requires an astounding 7,500:1 compression ratio. Even with a small 160-by-120 video window, it takes a compression ratio of 470:1 to make a 28.8-Kbps connection workable. This extreme compression, achievable only by lossy techniques, causes tremendous distortion in the form of blockiness, pixelation, and gross artifacts. We found that quality improves to some degree at compression levels suitable for 64-Kbps connections (single-line ISDN), and even more at 128 Kbps (dual-line ISDN). But at modem connection speeds, the technology is barely usable.

Web TV Tunes In

Web-based video is on its shakedown cruise, and there are plenty of glitches to hammer out. But the basics are there and the potential is enormous.

By Jan Ozer

In 1992, at the dawn of multimedia, video codec developers released grainy, distorted 160-by-120-resolution video that barely played at 15 frames per second from single-spin CD-ROM drives. Heralded by some but discounted by most, such codecs ushered in the term "postage-stamp video," a stigma that digital video has only recently overcome.



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It's also worth recalling that as a medium, video is much more demanding than audio, both technically and artistically. You can achieve surprisingly good audio results in a quiet room with a \$35 microphone and a \$200 Sound Blaster. By contrast, video demands proper acting, lighting, staging, and professional-level equipment to achieve good quality, even when you have the luxury of double-spin CD-ROM playback. With video made for 28.8-Kbps, 64-Kbps, or even 128-Kbps connections, high production standards are absolutely critical.

Overall, Web authors must set minimum artistic and technical quality levels by evaluating the essential purpose of the video that will be transmitted to the target users. Then they must take a hard look at whether that quality is obtainable at the connection speed typically used by the target audience.

If you need sound and action but the demands of video are too steep, several alternatives exist that may fill the gap. For example, Shockwave lets you integrate Macromedia Director multimedia animation into Web pages, while Apple's QuickTime VR lets you create impressive virtual-reality scenes that users can freely navigate (both products are discussed in sidebars).



*Video is a much more
demanding medium
than audio, both techni-
cally and artistically.*

STAKING OUT THE EXTREMES

To be included in this review of streaming video technologies, products had to have been commercially available or publicly accessible on the Web at the time of testing. Our search turned up only two: StreamWorks, from Xing Technology Corp., and VDOLive, from VDOnet

Corp. Our tests revealed them to be a study in contrasts, staking out the outer limits within which most future market entries will fall.

Most striking was the difference in their approach to achieving low-bandwidth video quality. Video has two components that affect the overall result: the absolute quality of individual frames and the display rate, or number of frames per second (fps) displayed. In developing a codec for low-speed connections, designers must choose one or the other, since they can't deliver both high-quality frames and a high display rate of 28.8 Kbps.

StreamWorks uses the high-quality, low-frame-rate approach, while VDO-Live opts for full motion and degraded frame quality. It was interesting to see how these choices affected video quality in scenes with large and small amounts of motion, and how each performed on the bench and in real-world Internet testing.

The extremely low-bandwidth connections that both products target dictated their choices of compression algorithm. StreamWorks uses a derivative of MPEG-1 while VDOLive uses a proprietary wavelet algorithm. StreamWorks' approach gives it access to industry-standard, market-proven, real-time compression

How We Tested Streaming Video

Our tests of streaming video products were less formal than our tests for audio products. Our goal was to see how well each product was able to adjust video and audio playback quality for a variety of connection speeds. We ran tests in a controlled networked environment and against production sites on the Internet.

We tested StreamWorks using Xing's proprietary turnkey AVTRANS audio/video encoder system, a DOS-based 486 PC with built-in audio and video capture capability. The AVTRANS system provided the raw audio/video feed that was then served to the Web using the StreamWorks server. The StreamWorks server resided on a Silicon Graphics Challenge Series server. We tested the VDOLive encoder on a Gateway 2000

P5-133, which we used to stream the video directly to the VDOLive player. We did not test VDOLive's PC-based server software.

We tested the player components of both products on a mix of Compaq 486/66M and HP Vectra XU 5/90C systems running Windows 95's Winsock and TCP/IP, connected to a 10-megabit-per-second (10-Mbps) Ethernet network. Live Internet connections were made through a 16-Mbps Token-Ring network to our corporate T1 backbone. Dial-up connections were done using Practical Peripherals' PPI 14.4-Kbps and 28.8-Kbps modems to our NetCom provider based in New York.

We used two video segments for our compression tests, one a high-motion sequence and the other a low-

motion "talking head." We compressed each video for target playback bandwidths of 14.4 Kbps, 28.8 Kbps, 64 Kbps (single-line ISDN), 128 Kbps (double-line ISDN), and network speeds (T1). We then examined playback quality produced by both products for each bandwidth setting, checking the quality of individual frames and the effective frame rate. We also looked for distortion in the form of blockiness, pixelation, and gross artifacts.

Finally, we used the player components of both products to access relevant production Web sites at 28.8 Kbps, 64 Kbps, and T1 speeds at all hours of the day to see how gracefully they degrade when the amount of available bandwidth diminishes.

—Analysis written by Jay Munro

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equipment, critical for the broadcast market Xing is heavily targeting. It allows StreamWorks to create audio/video streams ranging in bandwidth from 28.8 to 150 kilobytes per second.

But VDOLive's home-grown wavelet algorithm is intrinsically scalable, something which may be key to the future of low-bandwidth video. And while the algorithm is proprietary, VDOLive's operating environment isn't. The company wisely chose to work within Microsoft's Video for Windows .AVI specification, so VDOLive will have access to a mature suite of capture and editing tools such as Adobe Premiere, Intel's Smart Video Recorder, and Ulead Systems' MediaStudio Pro.

While the future will bring innovations, these two tools embody your current choices for authoring video on the Web. It will be interesting to see how effective each approach proves to be.

Xing Technology Corp.

StreamWorks

ALL REVIEWS BY JAN OZER

StreamWorks' streaming video technology offers the unique advantages also found in Xing Technology Corp.'s StreamWorks audio product. Its real-time, multipoint broadcasting capability makes it the only real choice for these applications, and its server software enables random access to the video stream, a feature that the competing VDOLive does not provide. StreamWorks stresses frame quality over display rate at lower bandwidths, producing crisp, high-quality frames that often look more like a slide show than video.

StreamWorks' prices are based on server-connection bandwidth and range from \$3,500 for a 1.5-megabit-per-second (1.5-Mbps) connection to \$50,000 for a 1,600-Mbps connection.

AUDIO/VIDEO ENCODING

StreamWorks' encoding requires Xing's \$6,500 AVTRANS turnkey hardware system, an Intel-based PC running a DOS-based encoder that compresses audio and video in real time. The system can broadcast video as it's compressed or store the compressed stream on a Unix server for subsequent transmission.

The AVTRANS system offers three schemes for audio encoding: MPEG-1 and MPEG-2 (which are compliant with the ISO specification) and the LBR (low bit rate) format used for streaming audio. The system offers a wide range of video configurations, from 96- by 96-pixel to 352- by 240-pixel resolution at 24 and 30 frames per second. StreamWorks gives you separate data-rate control over both the audio and video components, from a combined maximum of 150 kilobytes per second (150 Kbps) down to 14.4 kilobits per second (14.4 Kbps).

FLEXIBLE DELIVERY TUNING

Xing uses an MPEG-1 derivative as its compression algorithm and offers user-selectable intra-frame (I-frame), predicted-frame (P-frame), and bidirectional-interpolated-frame (B-frame) sequencing (MPEG compression uses these different frame types to maintain image quality). At lower data rates, StreamWorks drops B- and P-frames, transmitting only the higher-quality I-frames. This scheme provides virtually unlimited control over the number and quality of frames delivered over the system each second.

For example, those seeking high-quality, quarter-screen frames could configure the video at 320-by-240 resolution, with an I-frame rate of 1 per second. In a 28.8-Kbps transmission, the

SUMMARY OF FEATURES

Web-Based Streaming Video Products

■ RES ■ V

Products listed in alphabetical order

	StreamWorks	VDOLive
Server		
Price of server software	1.5-Mbps server connection, \$3,500; 1,600 Mbps, \$50,000	10 streams, \$1,995; 100 streams \$9,999
HPUX/LINUX/BSOI	■ ■ ■	■ ■ ■
Macintosh, OS/2 platform	■ ■	■ ■
SGI/Sun Solaris/SunOS 4 x	■	■
Windows NT	■*	■
Remote monitoring	Via telnet	Via telnet
Transmission protocol	UDP	TCP/IP, UDP
Multi-point broadcasting	■	■
Encoder		
Price	\$6,500	Free with server
Windows 95, Windows 3 x	N/A	■ ■
DOS, OS/2, Unix	N/A	■ ■ ■ ■
Real-time encoding	■	■
Input file formats	Composite Analog Video	.AVI
Bandwidth presets	28.8 to 256 Kbps (scalable)	14.4 to 256 Kbps (scalable)
Compression algorithm	MPEG-1	Wavelet
Batch capabilities available	■	■
Player		
Price	Free	Free
Windows 95/3 x/NT native	■ ■ ■	■ ■ ■
OS/2 native	■	■
Unix native	■	■*
Macintosh native	■	■*
Available as standalone	■	■
Available as helper application	■	■
Available as Netscape 2.0 plug-in	■	■
OLE	■	■
Minimum suggested connection speed	9.6 Kbps	14.4 Kbps
Decoder download size	1.4MB	0.4MB
Maximum resolution	352 by 240 pixels	240 by 180 pixels
Frame rate settings (frames per second)	24 or 30	15
Integrated status bar	■	■
Timer display	■	■
Can start at random points	■	■
Can stop and resume	■	■
Volume control	■	■
Rewind/fast-forward	■ ■	■ ■
Adjustable download memory buffer size	■	■
Local/Web-based online help	■ ■	■ ■
Player does not expire	■	■

* This feature is slated for the product's final version but was not available in the downloadable version we tested

N/A—Not applicable. The StreamWorks encoder is a proprietary hardware/software turnkey system

screen may update only once every 4 or 5 seconds, but the frame quality is still consistently high.

Whenever the system drops frames, it drops all B- and P-frames, which are the frames most affected by motion under the MPEG compression system. In effect, this means that motion has little or no impact on video quality at lower bandwidths. This was confirmed on our tests that involved

both high- and low-motion sequences.

Xing uses a similar system to let a single file service requests for multiple data rates. For example, a high-bandwidth network or T-1 connection could play a stored file at full frame rate, while a 28.8-Kbps connection might receive one frame every 4 or 5 seconds.

In PC Labs' testing at 14.4 Kbps, individual frames

were slightly pixelated and blocky, and new frames displayed every 10 or 12 seconds. At 28.8 Kbps, frame quality degraded slightly, but frames updated every 2 or 3 seconds.

Frame quality improved at 64 Kbps, and the display rate increased to about 1 frame per second, doubling to 2 frames per second at the same quality at 128



StreamWorks uses the same player for audio and video. The browse button lets you surf for active video and audio servers.

Kbps. At network speeds, all frames displayed at normal MPEG-1 quality. Overall, we noticed little or no quality variation between high- and low-motion video clips. This contrasted with what we saw with VDOLive, where the content of the video had a marked influence on the quality of playback. Xing generally performed well on tests against real production sites.

At peak usage periods, we found that audio broke up occasionally.

NOT FOR THE MEAK

Working with Xing's encoding system is not for the meek. The AVTRANS compression system was sorely underdocumented, and critical sections were missing from the manual. There was no documentation for the StreamWorks server.

Once up and running, however, the system performed flawlessly. The StreamWorks server, player, and page integration schemes are identical to the StreamWorks audio technology (see the audio section of this story for details).

Overall, Xing's high-quality, slow-frame-rate approach ensures that no one gets ugly pictures from an Internet connection. While StreamWorks is best suited for those with ISDN and faster connections, image quality can be maintained even at 28.8 Kbps, albeit at slow slideshow frame rates. For applications that demand random access, or for real-time encoding and transmitting, it's the only show in town.

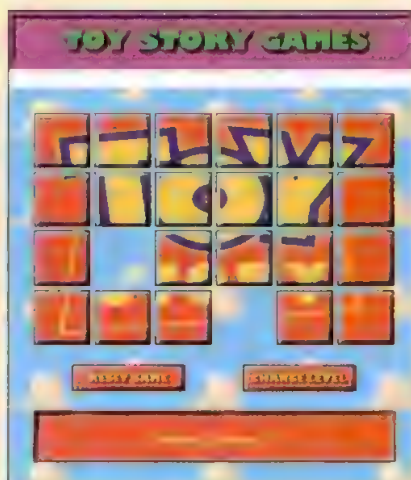
StreamWorks. List price: Depends on

Macromedia's Shockwave for Director

By Rick Ayre

Shockwave for Director, from Macromedia (800-470-7211), is easily defined: It's a plug-in for Netscape Navigator that plays Macromedia Director files downloaded from the Internet. But what it does to Web pages is almost impossible to describe. It brings them alive with sound, colorful animation, video, and most important, interactivity with the user—all the things that have made Macromedia's multimedia authoring tool famous. Shockwave turns the Web into the interactive medium that languages such as Java can only promise for the future.

Shockwave has many similarities with the audio and video technologies reviewed here. For example, it is a codec with two components. Shockwave's encoder, Afterburner, is a postprocessor that compresses ("shocks") your Director files for faster transfer across the Internet.



Interactive-games: one of many possibilities.

The Shockwave player downloads shocked Director files and decompresses them on the fly. Playback occurs seamlessly inside the Navigator browser, so Shockwave elements appear as an integral part of the page.

There are differences, however. For one thing, Shockwave does not use a lossy compression codec. The file you get at the receiving end is identical to the original created in Director. This limits the compression ratios that Afterburner can achieve, and Shockwave files are typically on the large side. Shockwave is not currently a streaming technology either, so that an entire file must be downloaded before playback occurs. While this isn't a problem with fast Internet connections, large files can be painfully slow over a modem link.

As we go to press, the Shockwave Plug-In is available only for the Netscape Navigator browser, and only for Windows 3.1x and Windows 95. Plug-ins for other Windows browsers and a Macintosh version are due soon, probably by the time you read this story. The Plug-In is available for free download from Macromedia's Web site (<http://www.macromedia.com>).

server-connection bandwidth. Xing Technology Corp., Arroyo Grande, CA; 805-473-0145; fax, 805-473-0147; <http://www.xingtech.com>. **Circle 443 on reader service card.**

VDOnet Corp. **VDOLive**

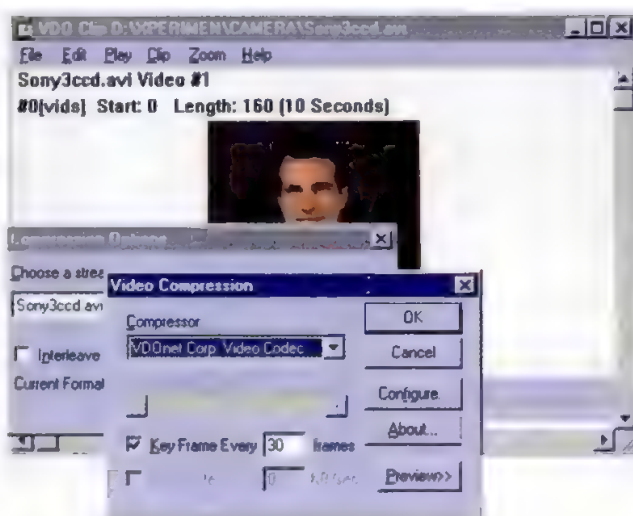
Scalable wavelet compression, dynamic bandwidth management, and use of the industry-standard Video for Windows format give VDOnet Corp. a solid blueprint for long-term success in the low-bandwidth video market. But we ran into here-and-now problems with its streaming video product, VDOLive, including incompatibility with most current Video for Windows tools and a disappointing player with no provision for random access. It delivered excellent quality over fast links but mixed results at single-line ISDN and slower connections.

DARLING WAVELETS

The wavelet algorithm, as used by VDO-Live, is the current darling of compression experts both for its high quality at low

bandwidths and for its inherent scalability. VDOLive's implementation divides each video frame into multiple layers, each of which provides additional detail and image quality. When sufficient bandwidth exists, all layers are transmitted to the viewer and quality is optimized. When bandwidth constricts, fewer layers are transmitted, degrading video quality but preserving motion and minimizing audio breaks.

This approach allows VDOnet to create one high-bandwidth file—256 Kbps, for example—that can be used to service requests from connections as slow as 14.4 Kbps. VDOnet complements its wavelet algorithm with server software that monitors the actual transfer bandwidth to the user and dynamically adjusts the amount



VDOLive's basic capture tools are short on special effects, but the vendor is moving toward supporting third-party tools.

of data transferred. This tunes video quality for each connection while preserving transfer bandwidth from the server to the Internet.

SERVER SOFTWARE

VDOLive is a server-based system whose pricing depends on the number of allow-

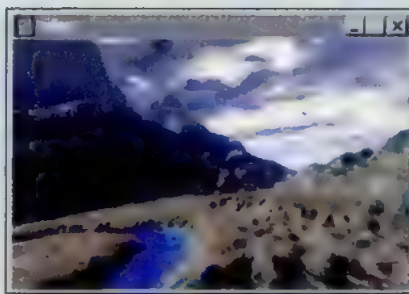
Apple's QuickTime VR: Almost Virtual Reality

By Rick Ayre

QuickTime is Apple Computer Corp.'s cross-platform standard for creating, using, and sharing video, music, text, and animation. But QuickTime VR is far more. It provides a wraparound virtual world within the confines of a window, which you can navigate through 360 degrees. You traverse such virtual scenes using the arrow keys or the mouse cursor.

On the Web, QuickTime VR is a download-and-play technology, and the player is implemented as a helper application. When you encounter a QuickTime file on a Web page, you click on the link, download the file, and run the QuickTime viewer to watch the movie. Typical files can be between a half and a full megabyte in size, and downloads over modem link correspondingly long. But the results are often well worth the time.

Most QuickTime VR scenes are



Navigating a virtual Eden through every point of the compass.

created photographically. Using a 35-mm camera with a 15-mm lens, the author takes a series of pictures, rotating the camera at a constant angle (usually 30 degrees) after each exposure. A photo service bureau then creates a montage of the photos. Finally, QuickTime VR creates a panorama by warping the images, creating the overlaps, and stitching the results together. Objects can be photo-

graphed from a central point or by using a camera that moves around a central object.

To view QuickTime VR, you need QuickTime for Windows and the QuickTime VR add-in, both available free of charge on the Apple Web site (<http://qtv.quicktime.apple.com/>). Ordering information for the QuickTime VR Authoring Tools Suite, Version 1.0.2, is available at the same site (or telephone 800-282-2732). QuickTime and QuickTime VR will both eventually be available as plug-ins as well as helper applications.

Our screenshot shows us navigating through one of Michael Radu's worlds, created using KPT Bryce 1.0.1 (<http://qtv.quicktime.apple.com/Radu.htm>). Today, QuickTime VR is being used to display everything from artificial worlds to fashion models. It's as close as you'll come to virtual reality without goggles and gloves.

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Internet Phones and Videoconferencing

By Cade Metz

If you have an Internet connection, you can make audio and video calls without paying a cent to your long-distance carrier. Several companies have developed IP-based software telephones that send and receive compressed speech over the Internet in real time, while Cornell University and

White Pine Software are offering a fledgling videoconferencing product that works over IP.

If you have a full-duplex sound card, each of the six IP phones that we looked at provides real-time phone calls in

which the transmission and reception of speech are simultaneous. When used with half-duplex sound cards, these products are more like CB radios than telephones, but they still allow you to call long-distance at zero cost. In addition to a sound card, you need an Internet connection over at least a 14.4-Kbps modem, a standard Winsock, speakers, a microphone, and someone with the same setup at the other end.

Unlike the other IP phones that were shipping as we went to press, Quarterdeck Corp.'s **WebTalk** (\$50 street price), from Quarterdeck (800-354-3222, <http://www.quarterdeck.com>), offers two different calling methods. When used as a standalone application, it supports only point-to-point calls; you simply enter the IP addresses of other users and call them directly. When used in conjunction with your Web browser, WebTalk lets you call other users via its IRC-like network of servers. After accessing the WebTalk Server Network home page, you can select a user from a digital directory or enter a chat room. Both

calling methods support typed chats and will offer video and shared whiteboard support in the near future. WebTalk ships with a copy of Quarterdeck's browser and two licenses.

The IP phone offering from Third Planet Publishing (214-713-2630, <http://www.planeteers.com>), **DigiPhone** (\$59.95), is limited to point-to-point

calling. The Third Planet home page does contain a complete directory of users, but it does not dynamically link you to those users; you must cut and paste individual names from this directory before making a call.

Like most of the other products reviewed here, DigiPhone lets you store frequently called users in personal, categorized phone books for easy access. You can also encrypt your calls, adjust the level of compression, and set the sampling rate. Unfortunately, DigiPhone—which ships with its own Winsock—does not run under Windows 95, but a version that does may be available by the time you read this.

Conversely, the aptly named **Internet Phone** from VocalTec (201-768-9400, <http://www.vocaltec.com>), allows you to call other users only through its network of servers. Its collection of 12 servers groups users into various discussion topics that can easily be joined or created. Frequently called users can be programmed into Quick-Dial buttons that are built into

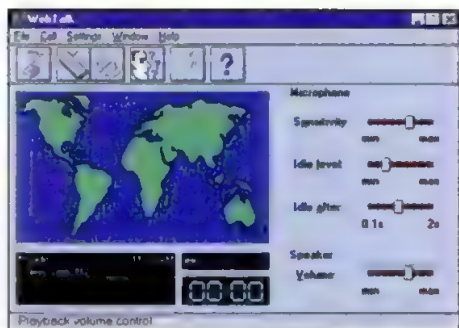
the main Internet Phone window. The VocalTec Web site offers a fully functional version of Internet Phone (\$69) and a free, 30-day trial version that limits you to 60-second conversations.

Three additional IP phones were still in beta versions as we went to press, but they will all be shipping by the time you read this review. The beta of **CyberPhone**—which can be downloaded from the CyberScience Web site (<http://magenta.com/cyberphone>)—provides point-to-point calling, a network of chat servers, text chat support, file transfer, and call forwarding. **CoolTalk**, from InSoft (717-730-9501, <http://www.insoft.com>), will offer text chat and shared whiteboard support, an answering machine, direct dial, and server lookup. NetSpeak (<http://www.itelco.com>) is currently offering the beta 5 release of its **WebPhone**, which is limited to point-to-point calls but provides directory assistance.

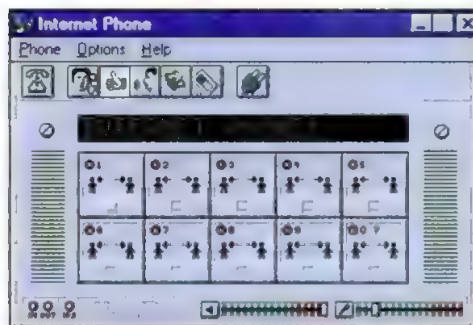
Current IP videoconferencing options are more limited. Shortly after introducing CoolTalk, InSoft will offer **CoolView**, a full-duplex audio/video package that supports both text chat and shared whiteboards. **Enhanced CU-SeeMe**, from White Pine Software (800-241-7463, <http://www.wpine.com>),

provides real-time video over the Internet, based on technology licensed from Cornell's CU-SeeMe development team. The free CU-SeeMe client, which is available for both Windows and the Macintosh,

lets you send and receive both 24-bit true-color images and 4-bit grayscale images as well as audio. For full functionality, you'll need at least a 28.8-Kbps modem and a camera with composite or S-video output.



Quarterdeck's WebTalk lets you call other users directly or over their server networks.



Internet Phone, from Vocal Tec, has Quick-Dial buttons that hold frequently called numbers.

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CIRCLE 039 ON READER SERVICE CARD

able streams. Prices range from \$1,199 for 5 streams to \$9,999 for 100 streams, with yearly support costing 30 percent of the purchase price. VDOLive recommends using a dedicated video server.

After you've installed the server software, you register the .VDO extension as a MIME type on the Web server. As Video for Windows files, all VDOLive videos have an .AVI extension. These are integrated into the Web page using a token text file with a .VDO extension that points to the location of the .AVI file on the video server. VDOLive uses a proprietary UDP transport mechanism that offers both bandwidth monitoring and error correction. Most firewalls should have no problem with VDOLive, and the company works directly with vendors to resolve any incompatibilities that crop up.

CAPTURE AND COMPRESSION

In choosing the Video for Windows architecture, VDOLive wisely opted for a platform with a rich set of capture and video-editing tools. Unfortunately, VDOLive's audio codec is accessible only through Windows 95's Audio Compression Manager, which few Windows 3.11 editing tools support. In addition, VDOLive's audio codec works only with 8-kHz audio, which few current audio capture devices support. This makes VDOLive incompatible with most current video editors such as Adobe Premiere, a situation that the company plans to address soon.

At present, VDOnet offers its own tools: VDO Capture and VDO Clip. They provide basic capture and compression functionality, but they have no advanced editing features such as transitions or special effects. VDO Capture is compatible with all Video for Windows capture cards, and it worked well with our Intel Smart Video Recorder.

TESTING

VDOLive's audio codec outputs only at an 8-Kbps data rate. We found the audio output crisp and clear, equaling or exceeding the quality of several audio-only technologies in informal tests.

The compression program has two video compression options,



*Tests over the Internet
were promising—
but not for users with
modem connections.*

one preconfigured for 28.8-Kbps transmissions and one that lets you select within a range from 8 to 256 Kbps. Compression was relatively fast, with a 47-second test clip compressing to VDOLive format in just over 2 minutes on a 133-MHz Pentium.

We tested compressing video for combined audio/video data rates of 28.8, 64, and 128 Kbps. At 28.8 Kbps, we found that clips with lots of motion were heavily distorted and very choppy, evidence of frames dropped during compression to maintain the requested bandwidth. At the

same data rate, clips with little action also showed obvious distortion, although they played smoothly with no evidence of frame dropping.

At 64 Kbps (single-line ISDN speed), high-motion clips remained distorted, with continued frame dropping, while artifacts were much less noticeable on low-motion clips. At 128 Kbps (double-line ISDN speed), high-action clips were still significantly degraded, while low-motion clips were nearly artifact-free.

Tests over the Internet were promising—but not for users with 28.8-Kbps modems. Playing a file from VDOnet's server at 28.8 Kbps yielded a throughput of from 12 to 20 kilobits per second as measured by the VDOnet Player. At this rate, VDOLive produced approximately 1 or 2 frames per second. The outlook was much brighter with our single line ISDN connection (64 Kbps), where we averaged from 23 to 30 kilobits per second and achieved playback close to 15 frames per second.

THE PLAYER

The VDO Player is available for Windows 95 and Windows 3.11. It should be available for the Macintosh and Unix in early 1996. Though professional in appearance, the VDO Player lacked one key feature: the ability to move through the clip with either a slider bar or fast-forward buttons. The player did provide several useful statistics, however, including current line throughput and audio and video frame-drop statistics. It operates both as a helper application and as a stand-alone player. It currently supports the Netscape 2.0 plug-in specification, and the company plans to add OLE support for Microsoft Internet Explorer by midyear.

Overall, VDOLive is an advanced technology, well packaged but slightly beyond the connection capabilities of the average Web surfer. But it could be extremely useful now for those who need to deliver video to users with high-speed connections. □

VDOLive. List price: Depends on the number of streams. VDOnet Corp., Santa Clara, CA; 408-654-8400; fax, 408-654-9447; <http://www.vdolive.com/>. Circle 446 on reader service card.



The VDOLive player is attractive but lacks navigation controls to let you move or fast-forward through the clip.



SERVER POWER

PC Labs tests six Pentium-powered departmental file servers running NetWare 3.12 and Windows NT Server 3.51.

By Padraic R. Boyle

The belt-and-suspenders approach may not take you very far in the world of high fashion, but it's just the ticket to success if you're in the market for a new departmental file server. A server that will be an asset—not a liability—to your company must not only be a top-notch performer with enough bandwidth to service all of your clients efficiently, it must also be

IN THIS REVIEW

Compaq Computer Corp.	159	The Rest of the Story: Windows
Dell Computer Corp.	162	NT 3.51 Server Performance
Digital Equipment Corp.	166	Network Testing
Hewlett-Packard Co.	170	Performance Tests
IBM Corp.	178	Summary of Features
IPC Technologies Inc.	182	The Pentium Pro
Editors' Choice	149	Microsoft File and Print
Suitability to Task	150	Services for NetWare
Price/Performance Index	159	RAIDers of the Lost Drive

1 UPS. Look for a UPS that can support the server's power consumption for 20 minutes.

2 VGA display. A 14- or 15-inch monitor is more than adequate for a file server.

3 4-mm DAT tape backup. Capacity should meet or exceed disk subsystem capacity.

4 Quad-speed CD-ROM drive. Install multiple drives for sharing data.

5 Lockable front panel. To protect your server against unauthorized access.

6 Hot-swappable hard disks. For configuring the disk subsystem in a RAID array.

7 ECC RAM. To preserve data integrity, purchase error correction-code memory.

Power supply. Ensure that wattage can handle a fully loaded configuration.

Minimum 100-MHz Pentium. CPU should support a 66-MHz system bus.

PCI/EISA bus. The server must have enough slots to handle all add-in devices.

secure, expandable, manageable, and fault-tolerant. File servers are no longer the inconsequential boxes sitting in the back of your server room, cranking out files: They're mission-critical pieces of machinery that must service increasingly demanding clients 24 hours a day, 7 days a week.

Most servers today are built to cater to specific environments. In this roundup, we elected to examine departmental file servers: systems suited for handling about 60 to 200 users in a department connected to a corporate backbone. For a server of this class, features such as hot-swappable hard disks, fault tolerance, robust management software, ECC (error-correction code) memory, and a cutting-edge design that will grow with your network are indispensable elements.

For this roundup, we raised the features bar from past file server reviews. We believe that if you're going to make such a large investment in one piece of equipment, you should get a total solution, not just a big, fast piece of hardware.

REVIEW CRITERIA

We asked each vendor to ship its departmental-level file server configured with 128MB of ECC RAM, 8GB of disk storage, and a single, fast Pentium processor. (We were a little too early to test Pentium Pro-based servers, but we expect to start seeing these shortly.) We recommended only that vendors install the fastest Pen-

tium that their server currently supports; this filter netted a wide range of CPUs, from a 90-MHz Pentium on the low end to a 166-MHz Pentium on the high end. We allowed vendors to send a machine capable of symmetrical multiprocessing—and indeed, all of them did—although we

RECENT REVIEWS

Two Paths to Power

February 20, 1996page 100
31 150- and 166-MHz Pentium PCs; 11 Pentium Pro PCs.

On the Road with the Pentium

January 23, 1996page 100
41 Color Pentium notebooks.

PC, Come Home

December 19, 1995page 136
32 Windows 95-equipped home systems.

asked that they install only one CPU for testing purposes, which is a more common configuration for file and print servers.

We also asked each vendor to include two 100-Mbps Fast Ethernet adapters with each server. In our last file server roundup ("Service with Style," *PC Magazine*, June 27, 1995), we found during testing that the servers were wirebound by our 10-Mbps Ethernet network. But our recently upgraded testing facilities now provide Fast Ethernet connections (see the sidebar "Network Testing: Pushing the Envelope"). These Fast Ethernet adapters—which are becoming very pop-

ular for server backbone connections—were just what we needed to enable our file servers to reach top throughput levels.

For our tests, we asked each vendor to install a 250-user license of NetWare 3.12. We do not add the price of the operating system to the price of the servers because many vendors rely on their resellers for the addition of the operating system.

We also required vendors to preinstall and configure the server management solution that they ship with their machine (whether it was their own in-house solution or a third-party management package). We asked for software that specifically manages their server hardware and monitors and gathers crucial performance statistics—not simply software for managing desktop PCs. We feel that server management is an extremely important part of a complete server solution, so we rate the quality of each vendor's solution as part of each comparative review. Server-specific documentation was also required for participation.

WHO'S HERE, AND WHO'S NOT

We received systems for this roundup from five well-known server vendors—Compaq Computer Corp., Dell Computer Corp., Digital Equipment Corp., Hewlett-Packard Co., and IBM PC Co.—as well as one relative newcomer to the server market, IPC Technologies. Excluding IPC, which just started selling servers in August of 1995, these vendors

HIGHLIGHTS

Departmental File Servers

The machines in this roundup represent the elite of today's departmental file server offerings. In fact, as a group, the vendors who participated in this roundup—Compaq, Dell, Digital Equipment, Hewlett-Packard, IBM, and IPC—accounted for about three-quarters of U.S. server shipments in 1995. We received all dual-processor-capable, Pentium-based machines, ranging in speed from 90 MHz to 166 MHz. And although we were a bit too early to test any Pentium Pro servers, expect them to arrive on the market by the second quarter of this year.

Fast Ethernet opens the pipe, clearing the way for record-breaking benchmark-test scores from our six departmental file servers. In previous file-server roundups, we found that the systems were simply too

fast for our 10-Mbps Ethernet network. Performance hit a ceiling because the servers were literally wirebound by the network. But an upgrade of our testing facilities—which now features state-of-the-art, 100-Mbps Fast Ethernet, high-speed switches, and Pentium-based clients—was just what was needed to speed up performance.

We tested these servers running both NetWare 3.12 and Windows NT Server 3.51, and the results indicated similar patterns across every server: The servers' total network throughput under NetWare was double the throughput realized with Windows NT at high client loads. This performance disparity exists because Windows NT simply cannot handle read and write requests as efficiently as NetWare.

Server management is a key ingredient in a well-rounded server solution. Functions of the server management software packages presented here ranged from basic system-monitoring capabilities such as temperature and voltage tracking to comprehensive out-of-band management features including remote dial-in and reboot.

It's a major investment: The servers here ranged in price from just under \$17,000 to nearly \$23,000. We required that each vendor preinstall 128MB of ECC system memory, 8GB of hard disk storage, and NetWare 3.12 with a 250-client license for testing. We did not, however, include the cost of the operating system in the servers' prices. Expect to pay about \$4,000 for a 100-user NetWare license.

accounted for about three-quarters of all server shipments in 1995 (see the chart "PC Servers and Super Servers: Market Share").

Although most of the major players in the server market today are represented in this roundup, we did catch a few vendors in the midst of revamping their product lines. These vendors include Acer America Corp., ALR, AST Computer, NEC Technologies, Netframe, Tricord, and Zenith Data Systems.

MORE SERVER, SAME PRICE

Affordability is an important issue when choosing a server. This year's crop of servers falls into approximately the same price range as the one we looked at in our last roundup of June 27, 1995. But now, you'll definitely get a lot more machine for your money.

Half of the servers reviewed here are based on a 133-MHz Pentium CPU; in our last roundup, most ran on a Pentium/100. We also required ECC RAM this time (which can cost up to \$50 more per megabyte than standard DRAM) and 8GB of storage versus 4GB last time. And since our last server story, many vendors have released newer, more powerful versions of their server management software packages.

INSIDE THE BOX

Compaq, Dell, and HP all sent servers for this roundup based on 133-MHz Pentium processors. Digital's Prioris HX 5166 features Intel's new 166-MHz Pentium CPU. At the lower end of the processor spectrum is IPC's Affinity XE, which runs on a Pentium/120, and IBM's PC Server 320, which is based on a Pentium/90. These CPUs put the latter two machines not only at a processor speed disadvantage but also at a system bus speed disadvantage (60-MHz, compared with 66-MHz L2 cache and memory buses for the Pentium/133 and the Pentium/166, and 30-MHz versus 33-MHz PCI buses).

All of the servers in this roundup are capable of supporting symmetrical multiprocessing, whether through an existing second CPU socket (Compaq, Dell, Digital, IBM, and IPC) or a processor board upgrade (HP). This feature allows the buyer to take advantage of a number of operating systems that scale to sup-

HP NetServer 5/133 LH

Selecting an Editors' Choice from a group of departmental file servers that represents the best that today's market has to offer was no easy task. But we deliberately set our standards high for this roundup, because

we wanted to test file servers that offered a complete, network-ready solution, including server management support; fault-tolerance and security features; and Pentium-class performance. Among the six departmental file servers that we received for this roundup—from six vendors that represented about three-quarters of U.S. server sales in 1995—we found one that stood above the crowd: the HP NetServer 5/133 LH (\$16,989).

Hewlett-Packard aims this machine at companies that need an all-in-one file server solution for mid-size workgroups, and the NetServer 5/133 LH ably meets the challenge. At the top of this 133-MHz Pentium-powered server's unique list of features is its bridged PCI bus design. This design incorporates one of the NetServer 5/133 LH's most exciting components: two on-board Fast/Wide SCSI-2 adapters. These adapters allow you to duplex the server's disk subsystem right out of the box, a capability that no other server on the market duplicates. The system also has five PCI slots, so it's ready for future expansion.

The NetServer 5/133 LH also features six hot-swappable drive bays, standard ECC memory, and SMP capability through a processor board upgrade. Add to this a strong showing on

our benchmark tests under both NetWare and Windows NT, and you have a winning combination.

HP includes a top-notch management package with the NetServer 5/133 LH in its NetServer Navigator CD. This CD contains NetServer Assistant 2.2, which not only monitors the server's health but tracks the activities of devices on your network as well. All of this information is viewable through HP's popular OpenView for Windows management environment, which is included on the NetServer Navigator CD.

We also found a server in this roundup worthy of an honorable mention: the Compaq ProLiant 1500 5/133 (\$17,599). This 133-MHz Pentium-powered file server's unique and well-implemented design certainly paid off on our benchmark tests. Not only was the ProLiant 1500 the top performer under NetWare, it outpaced all the other servers we tested under Windows NT as well.

The ProLiant 1500 is also supported by one of the best server management solutions available: Compaq's SmartStart for server setup and Insight Manager for system and network management. SmartStart allows you to install and optimize the configuration of a variety of popular NOSs, and Insight Manager monitors more than 800 server features and functions.

port multiple processors, including Windows NT, OS/2 SMP, various flavors of Unix, and Novell's long-awaited NetWare 4.1 SMP.

All of the systems offered a mix of EISA and PCI buses. But two systems here offer an exceptional level of PCI expansion potential: our Editors' Choice, the HP NetServer 5/133 LH, and Digital's Prioris HX 5166. Both machines

are able to offer extra slots because they use a bridged PCI bus design. In the NetServer, the primary PCI bus consists of two built-in Fast/Wide SCSI-2 adapters and one standard PCI slot; the secondary PCI bus features an additional four PCI slots (one shared with an EISA slot). By contrast, in the Prioris HX 5166, Digital incorporates a total of six on-board PCI slots.



DEPARTMENTAL FILE SERVERS

How to Read the Suitability to Task Boxes

The **expandability/scalability** rating reflects a server's ability to be upgraded. Principal considerations include the number of drive bays available, maximum amount of system memory supported, presence of a redundant power supply, and the number and type of expansion slots available (with an emphasis on PCI and EISA slots).

The **performance** rating is a measure of how well a server performed on our NetBench 4.0 tests. Servers rated excellent in this category garnered high throughput ratings under both NetWare 3.12 and Windows NT Server 3.51.

The **security/fault-tolerance** rating indicates to what extent a server provides redundant components and

implements basic security features. We take into consideration fault-tolerance levels supported by the system's disk controller, the presence of case key locks, hot-swappable hard disks, BIOS-based passwords, and multiple power supplies. Servers rated excellent in this category deliver strong insurance against data and hardware tampering.

The **server management** rating gauges the quality of each vendor's server management solution. Systems rated excellent in this category provide asset management, network management and fault-tracking features; remote alerts via pager, modem and SNMP; and network operating system setup and configuration utilities.

SUITABILITY TO TASK

Product name

Expandability/ scalability	Excellent
Performance	Good
Security/ fault tolerance	Fair
Server management	Poor

For network connections, all servers used PCI-based network interface cards. Both the Compaq ProLiant 1500 and the Digital Prioris HX entries each used its vendor's own NIC—the NetFlex-3/P and the DE500 PCI, respectively. Both the HP NetServer and the IPC Affinity XE used Cogent's EM110 TX PCI Ethernet adapter, while the Dell PowerEdge came with 3Com NICs. IBM used its licensed version of Intel's EtherExpress PRO/100B PCI adapter, the Editors' Choice in our recent roundup of Fast Ethernet adapters ("Shifting into High Gear," *PC Magazine*, December 19, 1995).

PERFORMANCE: BETTER THAN EVER

We measured server performance using the Disk Mix portion of our NetBench 4.0 benchmark tests. Our newly upgraded Fast Ethernet-based testing facilities provided an excellent foundation for gauging these servers' capabilities. Not only were the machines no longer wire-bound by 10-Mbps Ethernet, but their throughput was not bottlenecked at the hub level because the network's 10/100-Mbps switching hubs greatly reduced network-based traffic collisions. Furthermore, the 60-node test network now features all 486- and Pentium-based clients, which allows us to make even greater demands on the server.

All servers were tested under both NetWare 3.12 and Windows NT Server 3.51 operating environments. We used NetBench's Disk Mix to measure total network *throughput* (the transfer rate at which data is passed between a server and a client) at an incremental number of client loads, from 1 to 60. We further ensured that our test-bed did not impede server performance by using Fast Ethernet NICs in the clients.

The test results were both exciting and intriguing. We saw record-breaking throughput levels, due partly to our Fast Ethernet network and partly to the fast speed of the servers. Even more interesting, however, was the wide gap in server performance under different operating environments: On the average, all systems posted throughput scores under NetWare that were more than double their scores under Windows NT. (See the sidebar "The Rest of the Story: Windows NT 3.51 Server Performance.")

To boost performance further, you can install multiple hard disks in your server. By spreading or striping the data across multiple drives, sequential data transfers are significantly speeded up. Each hard disk can supply adjacent portions of requested file data concurrently, and the movement of each individual

disk's read/write head is reduced when accessing data in a particular file, thereby reducing the access time.

We asked vendors to configure their servers' disk subsystems with 8GB of storage, using four 2GB hard disks on a single SCSI channel. We then striped the disks using the OS to create one logical volume for testing purposes. Better performance is possible when using multiple channels, but the level of fault tolerance may be reduced.

FAULT TOLERANCE

Hot-swappable disk subsystems, which allow you to remove and replace a failed disk without downing the server, are an appealing feature for departmental-level file servers. When coupled with some form of drive redundancy such as RAID, hot-swappable drives increase server up-time.

All of the servers in this roundup—with the notable exception of IBM's PC Server 320—support hot-swappable disk subsystems. But this capability was better implemented in some servers than in others. For example, Dell's PowerEdge features eight hot-swappable drive bays, but you must remove the server's casing to access the drives, which hampers access and can slow down disk replacement (a minor problem for time-sensitive, mission-critical operations).

Most of the systems here also support hardware-level RAID, whether as configured for testing (Dell with its Dell SCSI Array, or DSA, EISA board; and Digital and IPC, which both used Mylex RAID controllers in their servers), or through an upgrade (Compaq offers its Smart SCSI Array RAID controller, while HP offers its PCI Dual-Channel Fast and Wide SCSI Array Controller). Once again, the notable exception here is IBM. The vendor did include an Adaptec Fast/Wide SCSI-2 PCI disk controller, but since the PC Server 320's disk subsystem does not support hot swapping, RAID support is highly unlikely.

There's no doubt that RAID—especially RAID 5—provides an additional level of data security; depending on the RAID level you use, it may also boost performance (see the sidebar "RAIDers of the Lost Drive"). But RAID can also be expensive to implement: To add a

Mobile Titan

Lithium Ion Power

Intel Mobile Triton Chipset

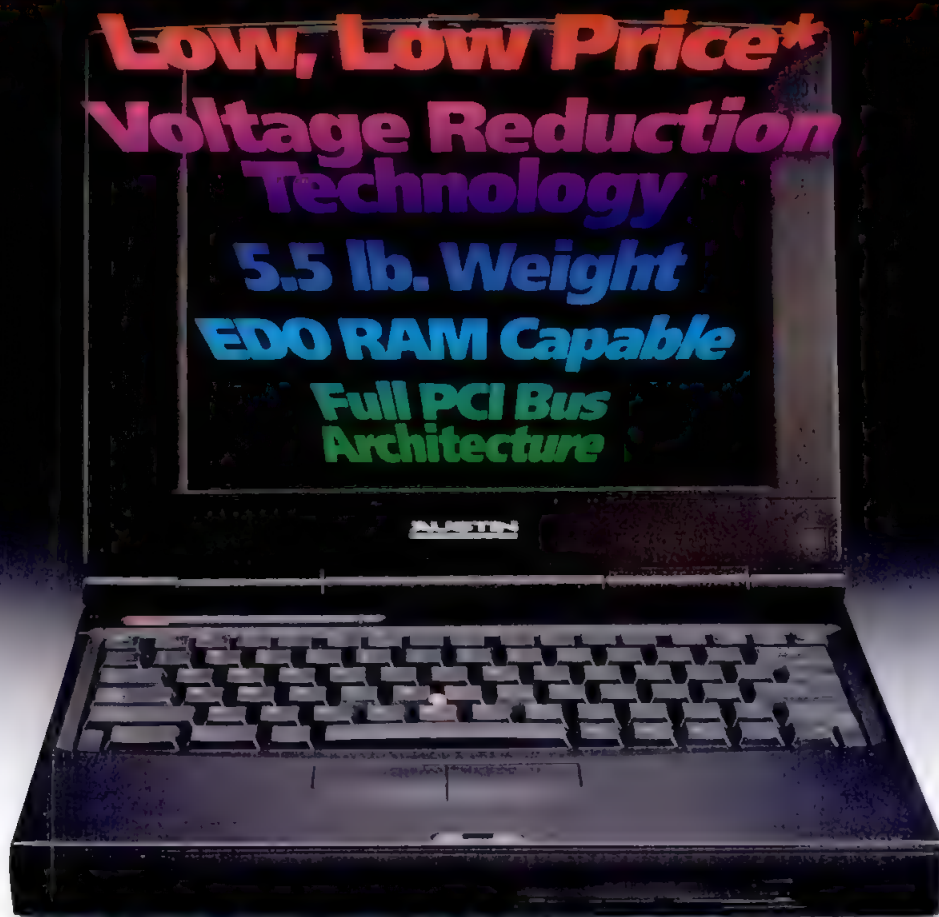
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One-Year Parts & Labor Warranty
Win '95 Plug n' Play BIOS
Windows 95 Pre-Installed

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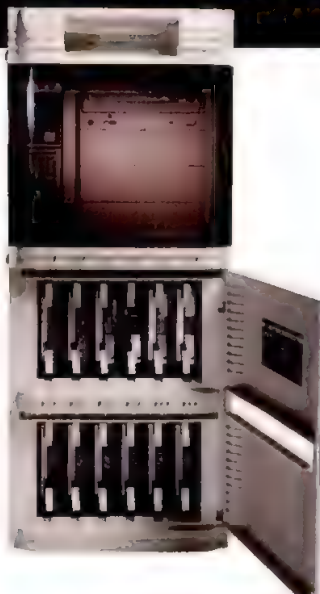
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Introducing the Austin Edge XP

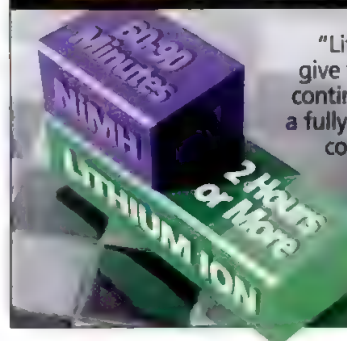
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Source: Magazine, July 1995

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hardware RAID controller to the Compaq and HP machines that we tested, for example, would cost about \$2,000.

An alternative to RAID is *duplexing*, which is very popular in server environments because it can provide data security through mirroring and is relatively easy to implement through the OS. One system here—the HP NetServer 5/133 LH—provides an easy route to duplexing through its dual integrated SCSI controllers, a setup that allows you to duplex the NetServer's disk subsystem right out of the box. Duplexing does offer potentially better performance, as well as a redundant controller, although it doesn't support hot-swapping.

Another fault-tolerance feature that you'll find in these machines is *ECC* (error-correction code) memory. ECC memory has the ability to detect and correct single-bit errors in memory. Except for IBM and IPC, all of the vendors here offer ECC memory with their servers as a standard feature. Although the maximum amount of ECC RAM installable varies from server to server, most allowed a maximum of 256MB. ECC memory is definitely more expensive to implement than standard DRAM (both at the design level and in the price of the memory modules), but the added level of data integrity is well worth the cost.

HARD DISKS: FAST AND WIDE IS BEST

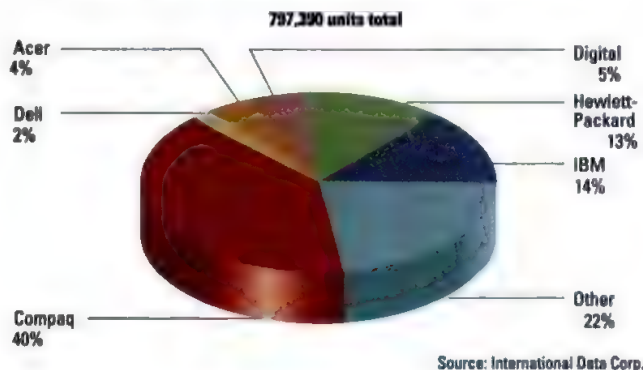
Two different SCSI-2 technologies are represented in this roundup: Fast/Narrow and Fast/Wide. Conventional Fast/Narrow technology supports an 8-bit data path and transfer rates of up to 10 Mbps; Fast/Wide doubles Fast/

Narrow on both counts, supporting a 16-bit data path and throughput up to 20 Mbps. Fast/Wide technology may give an extra boost to your server's performance, especially in a disk-intensive environment.

Digital and IPC each used a Fast/Wide Mylex adapter, while IBM used an Adaptec Fast/Wide controller; all were PCI based. Compaq's ProLiant 1500 also uses a PCI-based Fast/Wide SCSI-2 adapter, but it is integrated on the motherboard. Dell was the only vendor here to ship Fast/Narrow drives with its server.

1995 U.S. Server Shipments

Compaq Computer Corp. held a commanding lead in server shipments in 1995: In fact, the vendor's share was nearly three times that of second-place IBM. And with Pentium Pro servers beginning to ship in volume in the third quarter of 1996, we expect this market to expand at a rapid pace.



The Dell machine's performance suffered, however, because of its EISA-based DSA adapter (others servers in this roundup benefited from speedier, PCI-based SCSI adapters), and its 3Com NICs, which we found in previous testing to use an unusually high amount of CPU bandwidth.

Though the HP NetServer 5/133 LH shipped with Fast/Wide drives installed, its integrated SCSI-2 adapters support only Fast/Narrow technology. Since the NetServer 5/133 LH's disk subsystem can accommodate either Fast/Wide or

Fast/Narrow drives, it is left up to the embedded SCSI-2 adapters to auto-sense the drives and funnel the data into the Fast/Narrow channel. (HP does offer an upgrade path to a Fast/Wide adapter, however.)

THE IMPORTANCE OF MANAGEMENT

We feel that a well-rounded and useful server management solution is a critical feature for any machine of this class. Once your new server is in place and operational, you must be able to keep a finger on its pulse at all times in order to ensure maximum uptime. Events should be monitored through user-defined thresholds that alert the network manager when an error occurs. Notification in the event of an alert or a failure is delivered in many different ways: on-screen messages, pager, e-mail, fax, and SNMP are among the most widely used.

All of the vendors here supply their own server management software package, although some are more feature-rich than others. Compaq's Insight Manager, HP's NetServer Navigator, and

IBM's ServerGuide are the most mature, as their high level of in-band management support shows (Insight Manager, for example, can monitor more than 800 system features).

Both Dell and Digital sent add-in boards (the Component Management Interface and Remote Server Manager, respectively) with their servers to manage system assets—including overall system status, voltage, and temperature—and to send remote notification via modem or pager in the event of a failure. Dell's solution is usable only for in-band management, but Digital's RSM EISA adapter ups the ante with extensive out-of-band management support. Because Digital's RSM board is connected to its own power supply, you can access the server over a dial-up line whether the server is operational or not. HP also offers its Remote Assistant adapter (\$900), which enables remote system access.

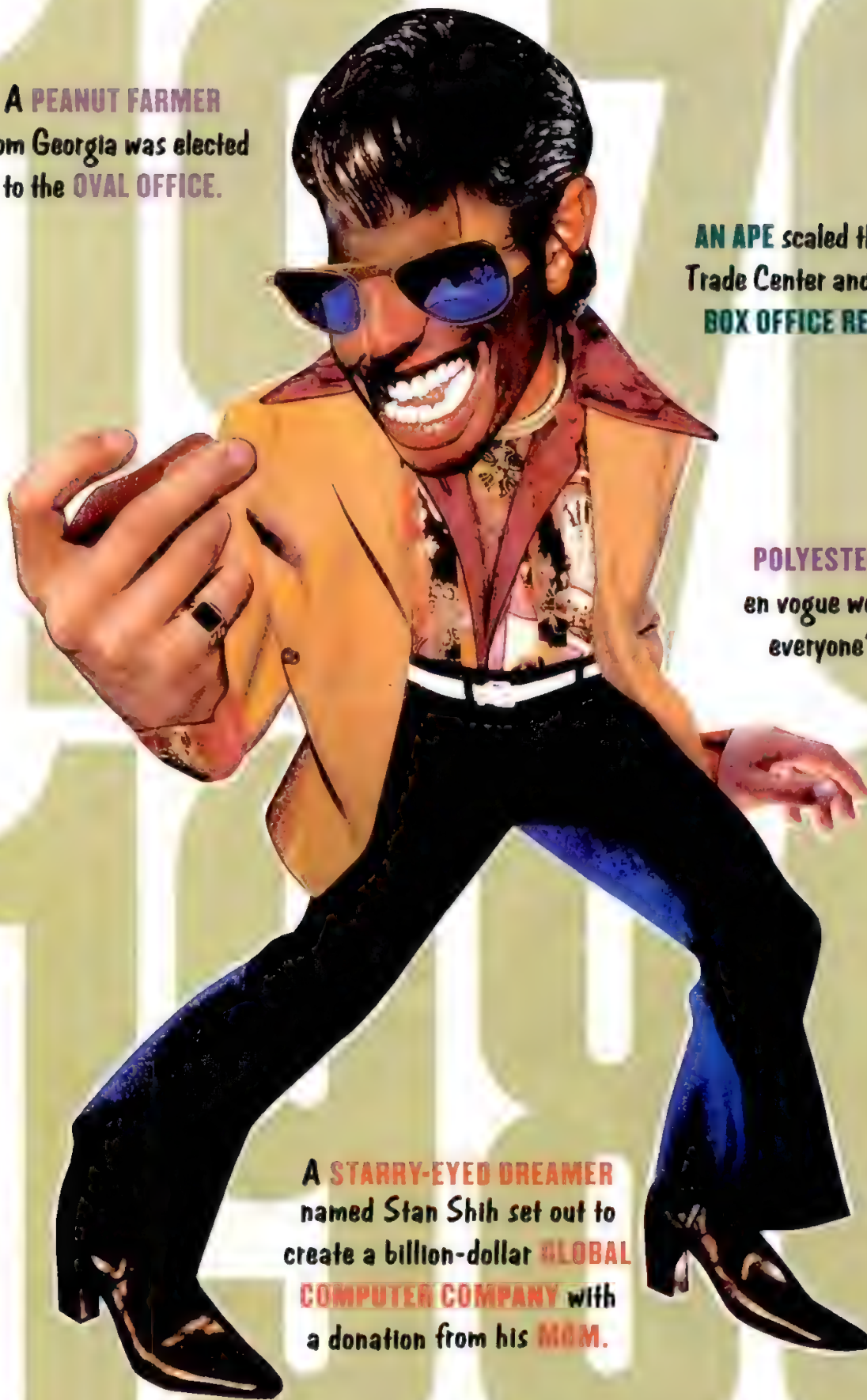
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create a billion-dollar **GLOBAL**
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1976

With the aid of a maternal contribution and a total of \$25,000, Stan Shih founds Acer® as Multitech International and begins his dream for a microprocessing enterprise.

Stout first brother upholds the dignity of his brother's Presidential status by licensing his name to a beer company.

1977

During an interview, Stan Shih tells prospective employee William Lu the company may go bankrupt. 18 years later, Lu is president of Acer Computer International, managing millions in global business.

Who could possibly play a thin-as-a-rail droid in the most successful science fiction film ever? The 90-pound British actor who was thin-as-a-rail enough to fit inside his armor.

1977

Acer America Corporation is established by Stan Shih for manufacturing, assembling, marketing, and selling microprocessor-driven technology throughout North America.

Charlie's Angels tops Nielsen ratings, proving that six-foot blondes with feathered hair are the archetypal detective heroes of the seventies.

1976

When everyone else sees typewriters as the core of productivity, Taiwanese entrepreneur Stan Shih envisions the microprocessor as the engine of business.

After keeping a low profile for 3,300 years in an Egyptian tomb, King Tut flaunts his wealth across America in an extravagant seven-city tour.

Acer assumes leadership role as high-tech gurus by opening a microprocessing center and training 3,000 engineers for Taiwan's information industry.

1978

Prank-happy, beer-swilling fraternity failures reach celebrity status when National Lampoon's Animal House debuts on big screen.

Human egg is fertilized outside female womb and world's first test-tube baby is born. And you thought hospitals were sterile.

1978

To promote computer literacy in Taiwan, Acer publishes Microprocessor Bulletin and establishes credibility in media for microprocessing savvy.

Multitech International begins incorporating microprocessors into electronic games and taps into rapidly growing consumer technology market.

1977

The King of Rock and Roll dies and is born again in cheesy Vegas lounges where desperate actors don the jumpsuit and sideburns to eke out a living.

Stan Shih's dignified business partner and wife Carolyn Yeh scrubs office floors and schleps around Taipei on a scooter distributing Acer bills.

1979

Headband-sporting tennis prima donna trademarks his million-dollar recipe for success with racket-throwing fits and prolonged swearing-at-the-umpire outbursts.

Acer introduces Chinese language CRT terminal and subsequently receives Taiwan's most prestigious design award.

1980

Millions show concern for a ruthless oil snake who destroys lives for pleasure when they tune in to watch the "Who Shot J.R." episode of Dallas.



Juggernaut Russian Ice Hockey team slips up to a bunch of college boys from the United States at the Lake Placid Winter Olympics.

1980

Acer starts mass-producing micro-processor-driven computer components for local manufacturers and begins exporting CRT terminals in bulk.

Who would have thought a company could be so far ahead of its time?

Yet even in the age of the information superhighway, Acer continues to pave the road.



To meet the demands of tomorrow, PC technology must be more advanced, accessible, and flexible than ever. That's why we deliver cutting-edge PC systems and components around the world. Acer always delivers the freshest technology—because all our global factories are located in key technology markets. Our research and development center in San Jose, California, has been setting the pace for years. They developed the first RISC-based PC, the first symmetric multiprocessing server, and the first 64-bit architecture for Windows NT."



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If all this is making you shake your head in disbelief, wait until you read our next installment, 1981-1985

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Price/Performance Index: Departmental File Servers

The leader on the performance/features scale is our Editors' Choice in this roundup, the HP NetServer 5/133 LH from Hewlett-Packard (\$16,989). This Pentium/133-powered server's features list is highlighted by its bridged PCI bus design, which incorporates dual Fast/Wide SCSI-2 controllers on the primary bus. These controllers allow you to duplex the server's disk subsystem without having to purchase any additional hardware. The bridged PCI structure also provides five PCI slots—one on the primary bus and four on the secondary bus (one is shared with an EISA slot).

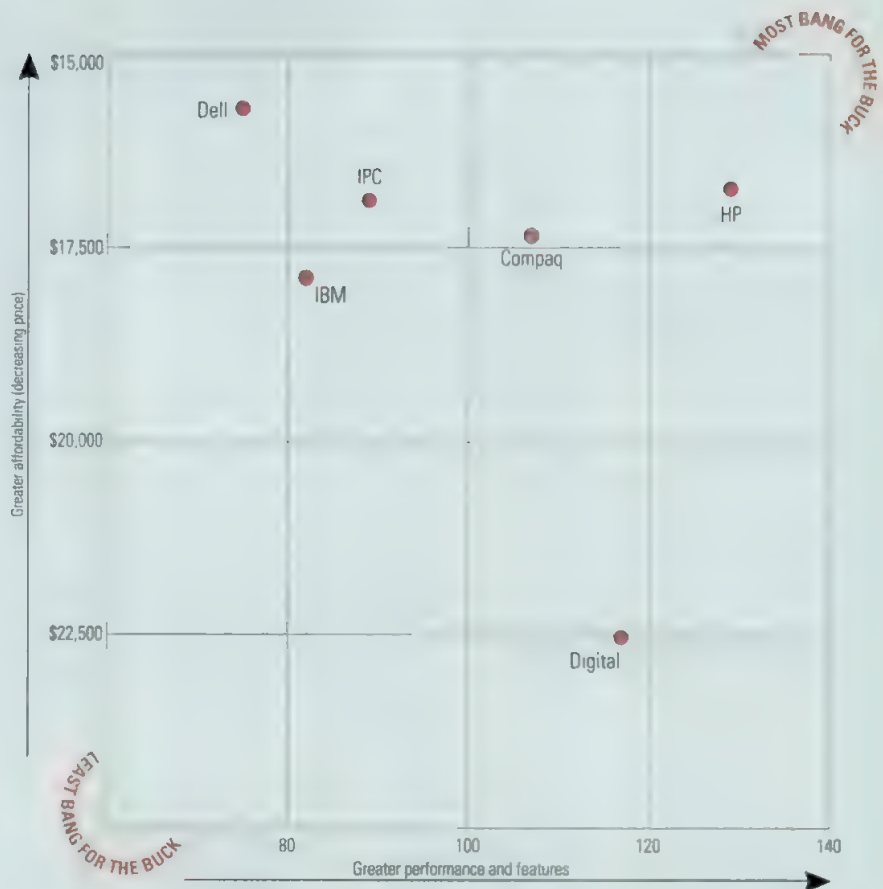
The HP NetServer 5/133 LH was also a top-tier performer on our NetBench 4.0 benchmark tests, under both Windows NT Server 3.51 and NetWare 3.12. Top-notch server management support through HP's NetServer Navigator completes this package.

THE DATA POINTS

Total Network Throughput scores on the Disk Mix portion of our NetBench 4.0 benchmark tests account for 45 percent of the performance/features score. System features including PCI and EISA slots, hot-swappable drive bays, and RAID levels supported by disk controllers comprise 35 percent of the score.

Both IBM's ServerGuide and Compaq's SmartStart walk you through NOS installation and configuration. HP's NetServer Navigator configures both EISA and PCI adapters and will create a disk with the drivers needed for NOS installation. Similarly, Digital's Quick Launch creates a disk with the drivers needed to install the NOS you choose.

The six reviews that follow should provide you with a better understanding of which departmental file server offers the best balance of performance, management, fault tolerance, and expandability to meet all of your requirements.



Management and service features, including remote reboot, hardware/NOS setup software, availability of 24-hour 7-day technical support, and length of warranty make up the remaining 20 percent of the score.

Price/performance data is available in the Hardware Library of the Editorial Forum on PC MagNet under 06BANG96.TXT and on the World Wide Web at <http://www.zdnet.com/~pcmag/pclabs/pclabs.htm>.

Compaq Computer Corp. **Compaq ProLiant 1500 5/133**

The workhorse of departmental file servers, the \$17,599 (street price), Pentium/133-powered Compaq ProLiant 1500 5/133 not only offers class-leading server management support through its Insight Manager package; it was also the top-performing system in this roundup. A solid server for most installations, the ProLiant still manages to keep pace with Digital and Hewlett-Packard servers when it comes to meeting the needs for newer technology. Compaq also

sells the ProSignia line of mainstream general-purpose file servers, as well as the ProLiant 4500 series of high-end application servers (which replaced Compaq's ProLiant 2000 and ProLiant 4000 lines), which can accommodate from one to four Pentium processors.

A convenient system layout allows easy access to all of the server's internal components including the installed 133-MHz Pentium processor, system memory banks (ECC memory is a standard feature for this machine) as well as all PCI and EISA expansion slots. The ProLiant features five hot-swappable drives that are accessible from the front of the system. If

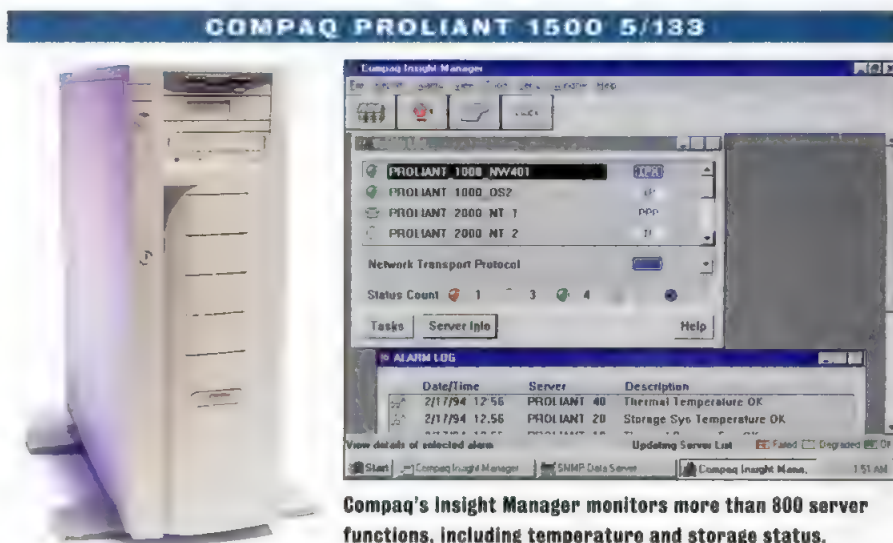
server room space is a concern to your business, you can purchase the ProLiant 1500 in a rack-mount configuration.

Three 5.25-inch drive bays are located on the front of the ProLiant 1500, two of which were used in our test system by the floppy disk drive and the double-speed CD-ROM drive. An integrated Fast/Wide SCSI-2 PCI adapter is used to control the data path for the four 2GB Seagate Barracuda Fast/Wide SCSI-2 hard disks in our test configuration. The drives are easily removed, as they are mounted in locking drive trays with handles; all drive lights are visible from the front of the server, which is an added convenience.

To expand your hard disk subsystem, Compaq also offers its Smart SCSI Array controller board with two Fast/Wide SCSI-2 channels that support up to seven devices each (a \$2,250 option, not included in the system price). If the machine's five hot-swappable drive bays are not enough for all of your storage needs, Compaq offers an external storage cabinet in its ProLiant Storage System, a \$1,199 option (also not included in system pricing) that holds a total of seven Fast/Wide SCSI-2 hard disks.

The ProLiant 1500 offers eight expansion slots: five EISA, two PCI, and one shared PCI/EISA. There is a proprietary slot on the motherboard for the system's FlexSMP Dual Processor board, which features two ZIF processor sockets (one of which was occupied by the installed 133-MHz Pentium processor; for an extra \$999, you can add a second 133-MHz Pentium), and 512K of synchronous L2 cache, the maximum available on the board. (With two processors installed, the 512K of L2 cache is shared between the two CPUs.) Eight memory slots are also located on this processor card, which will accommodate a maximum of 256MB of ECC RAM.

Other than Digital, Compaq was the only vendor in this roundup to include its own network adapters. However, Compaq's unique NIC implementation proved better than most. The vendor's NetFlex-3/P network cards offer high performance, in addition to a high degree of flexibility. With a \$113 optional snap-on module, the NetFlex-3/P can be trans-



Compaq's Insight Manager monitors more than 800 server functions, including temperature and storage status.

formed from a 10Base-T half-duplex adapter to a 100Base-TX full-duplex adapter. The NetFlex-3/P also supports 100VG-AnyLAN and Token-Ring (these modules are also priced at \$113 each).

A series of fans are used to circulate air throughout the server's housing, including one fan that is positioned beside the drive bays for added cooling. Moreover, like the Digital Prioris HX, the ProLiant cannot be turned on if the chassis cover is not in place. This ensures that proper system cooling is enforced.

On our benchmark tests, the ProLiant 1500 was the best performer overall, leading the pack throughout. Under NetWare,

the ProLiant 1500 broke away from the pack after 20 clients. Its throughput increased as more clients were added, and it beat out both the Digital and the Hewlett-Packard entries for top throughput honors with a full 60-client load.

Under Windows NT, the ProLiant 1500 was again the performance leader. It took off after only four clients and peaked at 16 clients. The system's throughput level tapered off slightly through to the 60-client level, but it still managed to hold a lead over the other servers we tested.

Compaq's server management solution begins with its SmartStart package, which allows network administrators to pick and install the network operating system of their choice, including NetWare 3.x, 4.x, and SMP; OS/2 Warp; SCO Unix; and Win-

dows NT. With SmartStart, you can also install and configure applications including Oracle Workgroup Server for NetWare and Windows NT; and ARCserve for NT.

A setup guide is provided that walks you through the installation of SmartStart and then Insight Manager, Compaq's management package. SmartStart will also optimize your configuration for the NOS you choose. Although other vendors (including Digital, HP, and IBM) have introduced their own versions of quick-install products, none of them match SmartStart in terms of useability.

Insight Manager is one of the most complete and comprehensive management packages available for a server today. This package supports monitoring and statistics of over 800 system features and functions, including processor, memory, hard disks, network adapters, and system temperature. Furthermore, Insight Manager can collect and generate fault-tolerance and fault-prevention statistics that can help limit server downtime. If an error does occur, Insight Manager provides notification to the network administrator via alarms, on-screen messages, pager, fax, and SNMP alerts.

Compaq backs the ProLiant 1500 with a three-year parts-and-labor warranty that includes on-site service for all three years.—*Padraic R. Boyle*

Compaq ProLiant 1500 5/133. Street price: \$17,599. Compaq Computer Corp., Houston, TX; 800-345-1518; fax, 713-518-1442; <http://www.compaq.com>. Circle 447 on reader service card.

SUITABILITY TO TASK

Compaq ProLiant 1500 5/133

Expandability/scalability	Good
Performance	Excellent
Security/fault tolerance	Fair
Server management	Excellent

The Rest of the Story: Windows NT 3.51 Server Performance

By Robert P. Lipschutz

During testing for this story, we were surprised to find such large differences between the file servers' performance under NetWare 3.12 and Windows NT Server 3.51. Although the servers' relative rankings were the same under both operating systems, the maximum throughput for each of the file servers with Windows NT Server was less than half that of NetWare. We wanted to know more. After all, on performance tests conducted in the past using four Ethernet segments, we found that servers performed similarly under both Windows NT Server and NetWare.

FAST ETHERNET OPENS THE PIPE

This time, we upgraded our performance test-bed to Fast Ethernet (see the sidebar "Network Testing: Pushing the Envelope"), and this made all the difference in the world. With our Fast Ethernet upgrade, we essentially moved the performance bottleneck from the network to the server itself. Providing a larger pipe to the server helped NetWare tremendously, but Windows NT Server could not use this extra bandwidth, simply because it does not handle read and write requests as efficiently as NetWare. We found that with up to 12 NetBench clients, Windows NT Server and NetWare performed on a par with one another, but as we added more clients, Windows NT Server stalled at about 33 Mbps while NetWare kept going up to a maximum of 70 Mbps.

What does this mean for you? If you are still using standard 10-Mbps Ethernet adapters in your file servers, both NetWare and Windows NT Server will become bottlenecked by the Ethernet network at high loads. We see very little performance difference between the two operating systems using Ethernet into the server, but we found noticeable performance differences with Fast Ethernet adapters in the server. Although our published test results were obtained with 100-Mbps Fast Ethernet adapters in

the clients as well, we found in other testing that the same results can be achieved with standard 10-Mbps Ethernet adapters in the clients, as long as the server utilizes 100-Mbps adapters.

BOOSTING NT SERVER PERFORMANCE

We asked Microsoft for configuration advice and did some of our own testing to find out more. Here are a few tips and tricks for getting more performance from Windows NT Server:

- First, as with any OS, use RAID 0 to stripe together multiple physical hard disks into logical volumes. This way, reads and writes are distributed across the hard disks, thereby mitigating the most common I/O bottleneck, the disk subsystem. We chose to stripe four hard disks in our test, but Microsoft suggested as many as eight. The downside of striping hard disks together is that if one spindle fails, the entire volume fails, and the more hard disks you add, the more chances for failure.
- Second, pick the appropriate file system for your needs. For Windows NT Server, NTFS provides the best security for important and confidential files, but as shown by our testing, you do pay a price in performance. Using the FAT file system, Windows NT Server performed about 20 percent better than with NTFS at both file systems' peak throughput levels (reached with 24 clients). We chose NTFS for our testing

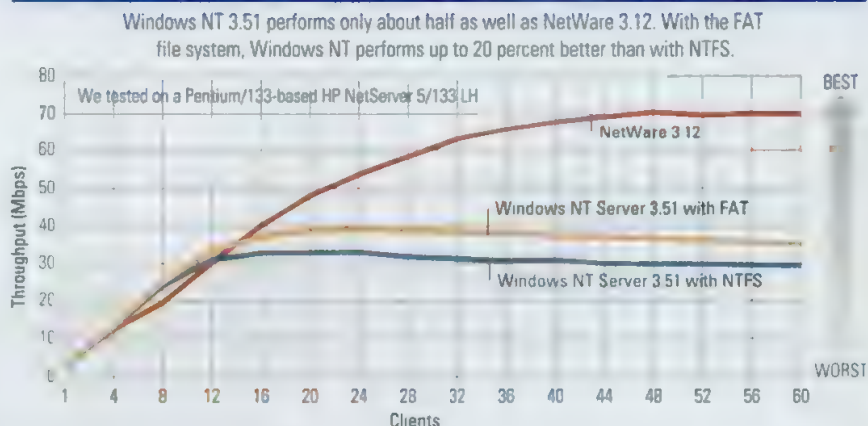
because we feel most companies will want the level of security that it offers.

- Third, Microsoft told us at the end of testing that they actually see better performance using a single Fast Ethernet adapter in the server. We used two Fast Ethernet adapters for our tests so we would not hit a performance bottleneck on a single network adapter. According to Microsoft, Windows NT Server performs better with a single adapter because of the way it handles interrupts.
- Finally, make sure you have the latest drivers for your hard disk controller and network adapters. In the case of Windows NT Server, make sure you have protected-mode drivers since they perform much better than real-mode drivers. Also, download and install Microsoft's Service Pack 2. Microsoft has made some major performance improvements in the Windows client redirector software.

UPCOMING CHANGES

Even with these changes, Windows NT Server has a way to go before it catches up with NetWare on our benchmark tests. Microsoft does plan to make some performance improvements with its next release of this OS, and third-party drivers will certainly improve over time. It will be interesting to see what performance improvements are made to Windows NT Server as Fast Ethernet products become more popular.

WINDOWS NT SERVER 3.51 VS. NETWARE 3.12



Dell Computer Corp.

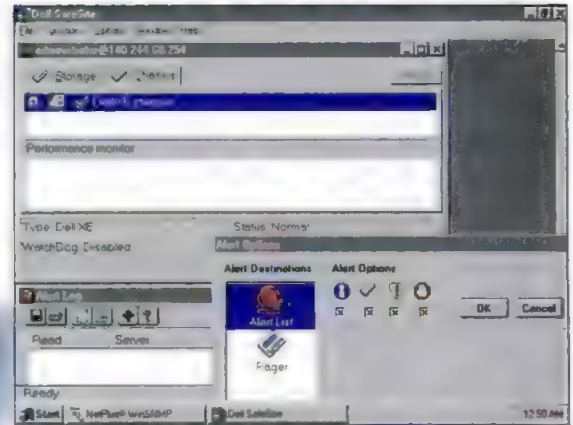
Dell PowerEdge XE 133-2

The Dell PowerEdge XE 133-2 (\$16,174 direct) offers excellent storage-expandability options both internally and externally, and a decent management solution through its SafeSite 2.2 software and Component Management Interface, which monitors server vital signs. System design shortcomings, however—such as difficult-to-access drive bays and memory slots, and only two PCI slots—hinder much of the server's functionality. Further, the PowerEdge XE's performance placed it at or close to the bottom of the pack on our benchmark tests under both NetWare and Windows NT. Dell targets its PowerEdge machines at mission-critical environments, emphasizing power, reliability, and expandability.

The PowerEdge XE supports eight hot-swappable hard disks that can be configured for mirroring, duplexing or RAID levels 0, 1, 4, and 5. In our test configuration Dell installed four Seagate 2GB Fast/Narrow SCSI-2 hard disks. The SCSI backplane that the drives plug into can be split into two separate four-bay configurations, or it can be set up as one continuous eight-bay configuration. To expand storage capacity beyond the server, Dell offers its EMS 1634 storage unit (a \$2,298 option for the physical unit only, hard disks and service not included), which provides up to 224GB of additional storage space.

One major drawback in the PowerEdge XE's design is the way that the drive bays are positioned in the chassis. To access the drives, the chassis cover must first be removed from the server. This makes it difficult to swap out failed drives, and somewhat negates the advantages of having a hot-swappable backplane design in mission-critical environments. Moreover, the drive lights are not visible from the front of the server. Four 5.25-inch drive bays were accessible from the front of the system, two of which were used to house the floppy disk drive and the NEC 6X CD-ROM drive.

Unique to the PowerEdge XE is the system's Dell-designed motherboard relative to the positioning of the I/O slots.



Dell's SafeSite monitors system temperature and hard disk status and delivers alerts via on-screen messages or pager.

The motherboard sits vertically within the case, and incorporates a 133-MHz Pentium CPU, a second processor socket (add \$1,659 to the above price for a second CPU), 512K of synchronous L2 cache, and eight system memory slots. A riser card with the I/O slots is connected to the motherboard via a proprietary slot. This design allows for easy access to the server's seven EISA, one PCI, and one shared PCI/EISA expansion slots. (Both PCI slots were taken by 3Com 3C590 NICs.) A video adapter and a PCI SCSI-2 adapter are integrated on the motherboard. To control the hard disks, Dell used its Dell SCSI Array (DSA) EISA adapter (a \$1,499 option, included in the above price), which also enables management functions.

The PowerEdge XE supports a maximum of 256MB of ECC RAM. Accessing the system memory, however, was somewhat of a hassle: you first have to remove four screws and several cables, and then remove the motherboard from the chassis. This process is avoidable, but only if you can insert memory modules without actually viewing the slots.

The PowerEdge XE accommodates two 300-watt power supplies, which is more than enough power to handle the needs of all of the devices in the server. However, there is only one power cord coming into the back of the server and it is shared between the two power supplies. This design defeats the purpose of having

a backup or redundant power supply.

Our benchmark test results showed the PowerEdge falling into the lower performance tier under both NetWare and Windows NT. Under NetWare, the PowerEdge XE initially held its own, running even with the Compaq ProLiant 1500 until 12 clients. At 36 clients the PowerEdge XE's throughput leveled out, and it ended up barely beating out the IBM PC Server for last place with a full 60-client load. Under Window NT, the PowerEdge XE's throughput rose steadily until it hit 12 clients, declined slightly, and then leveled off, coming in last at 60 clients.

For server management, Dell offers its SafeSite 2.2 software package and a new on-board feature called the Component Management Interface (CMI) to manage the PowerEdge XE's vital signs. SafeSite supports both NetWare and Windows NT, and to manage your network, it snaps into other network management platforms including Intel's LANdesk and Hewlett-Packard's OpenView.

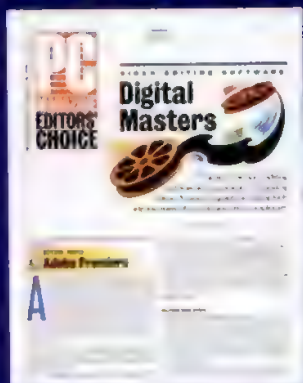
The CMI chip set has wire leads that attach to various components in the server, including the DSA board, the CPU, and the drive bays. SafeSite, in conjunction with CMI, monitors the server's temperature, power supply, voltages, and hard disks, within user-defined thresholds for some functions. In the event that an error occurs or one of the user-defined thresholds is met, SafeSite will notify the network administrator via on-screen alerts and pager. SafeSite also brings

SUITABILITY TO TASK

Dell PowerEdge XE 133-2

Expandability/scalability	Fair
Performance	Fair
Security/fault tolerance	Poor
Server management	Fair

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Network Testing: Pushing the Envelope

By Robert W. Kane

To test the file servers in this roundup, PC Labs utilized the network facilities located at ZD Labs in Foster City, CA, the home base for most of *PC Magazine's* network-related testing. Within ZD Labs is the LAN Lab, which is designed to accommodate testing of a full spectrum of networking products, from file and application servers to network operating systems, e-mail packages, and relational databases. The LAN Lab houses 300 PCs, which are divided among five identical 60-node networks. This setup allowed us to perform side-by-side comparisons of the servers in this review.

The purpose of the LAN Lab is to generate real-world network traffic in order to test networking products. By using real PCs in conjunction with NetBench 4.0 and ServerBench 2.0 (our network benchmark tests), we are able to put workloads on servers which closely resemble the workloads that a server might face when deployed in the enterprise.

TIME FOR A CHANGE

During our last file server review, we noticed that by optimizing the performance parameters of the servers, many of them were able to achieve throughput equal to the maximum capability of our network infrastructure—four 10-Mbps Ethernet segments feeding into the file server. Hooked to each of those segments were PCs ranging from 386SX/20-based systems on the low end, to 486DX/33-based PCs on the high end.

But as server technology has continued to advance, and network

applications have begun to incorporate more multimedia features that demand higher server bandwidth, it's become obvious to us that our existing LAN Lab infrastructure needed to be upgraded to match the capabilities of the servers we were testing. If we did not upgrade, all servers would soon appear identical on a performance scale.

We set out to perform an upgrade of the LAN Lab which we felt mirrored the upgrade direction of future networking infrastructures. We paid particular attention to four areas: client computers, network adapters, network wiring, and the switching fabric that ties all the pieces together.

UPGRADING THE CLIENTS

The first step in the process was to upgrade our ancient—by today's standards—client computers. With Windows 3.1 as today's corporate OS standard, Windows 95 coming on strong, and Windows NT with a powerful toe-hold, all of the 386-based PCs in the Lab were deemed expendable. We replaced these systems with 133-MHz Pentium machines with 16MB of mem-

ory and 1GB hard disks.

The 33-MHz 486-based units were not as expendable. With a little work, we knew we could make them usable, so all of them were upgraded to 486DX2/66 CPUs, 500MB hard disks, and 16MB of RAM. These disk and memory levels were necessary because all systems are set up to tri-boot among DOS/Windows 3.1, Windows NT Workstation, and Windows 95. Since the majority of the systems are 486DX2/66s, we felt that we had a good mix between the 486- and Pentium-based systems.

THE FAST ETHERNET CHOICE

Next, we turned our attention to the network adapters. With the advent of affordable, high-speed networking upon us, sticking with 10-Mbps Ethernet seemed to make no sense. But given the ubiquity of 10-Mbps Ethernet within the enterprise, we felt it was necessary to retain the capability to run 10-Mbps Ethernet if the need arose. So we made a buying decision much like any network administrator, and we purchased 10/100 Ethernet adapters that can be used at either data rate.

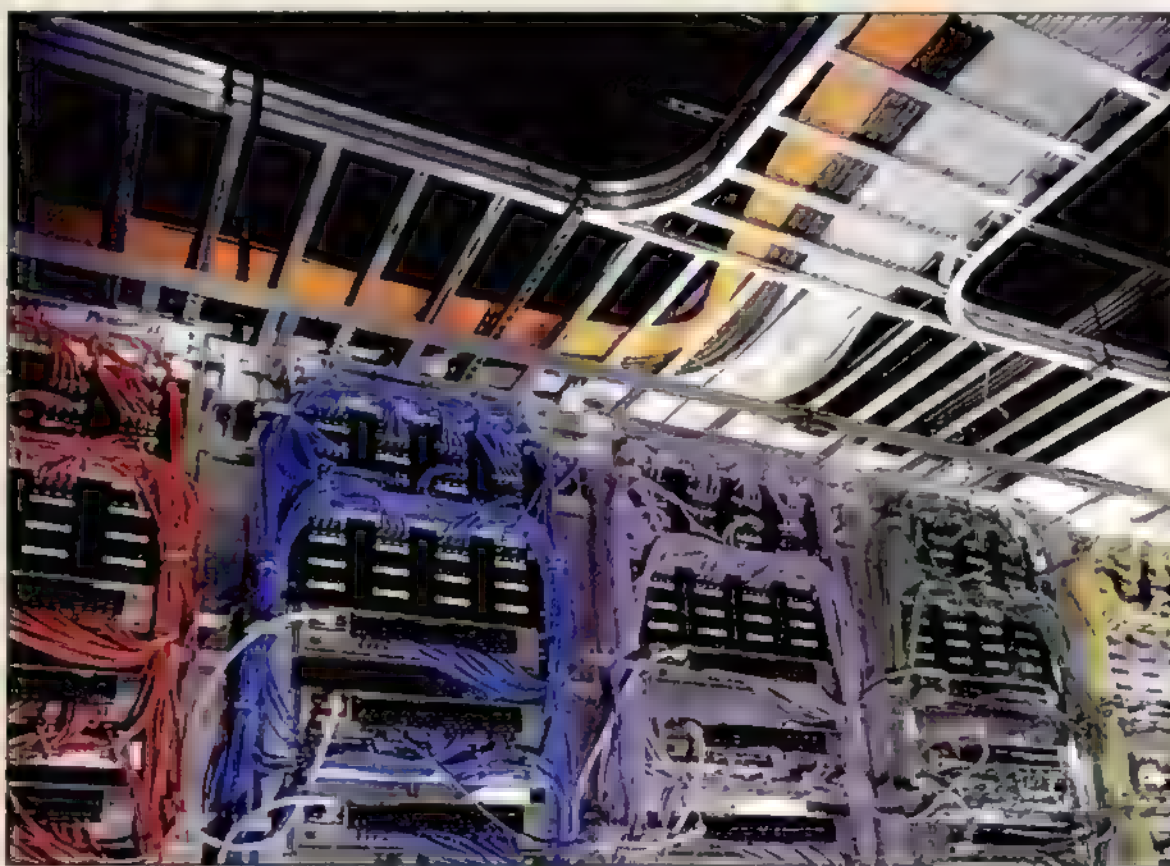
We chose 100Base-T adapters for our network clients. From Intel, we chose Intel Ether-Express PRO/100B PCI network adapters for our Pentium PCs. For some of our 486-based systems, we used EISA cards. For our 486DX2/66-based ISA clients, we chose National Semiconductor's 10/100 InfoMover adapter. The combination of pricing, platform support, and our need (for support reasons) to limit the number of different adapters led to these choices.

WIRING IT ALL TOGETHER

It was then time to turn our attention to the net-

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Bay Networks' LattisSwitch 28115 Ethernet switching hubs support both 10- and 100-Mbps switched connections.

work cabling in the LAN Lab. At the time the LAN Lab was built, it was wired with Category 4 cabling, which is perfectly suitable for 10-Mbps Ethernet. But for 100-Mbps Ethernet applications, Category 4 cabling is unacceptable, simply because it just won't work with current 100Base-T products, which are based on a Fast Ethernet standard called 100Base-TX. (The only 100Base-T product—based on a standard called 100Base-T4—that will work with Category 4 cable has just shipped.)

We removed all of the Category 4 cabling and replaced it with approximately 10 miles of Category 5 cabling. Because new networking installations today typically use Category 5 wiring, we felt that this configuration represented an advanced network infrastructure.

Finally, we had to hook all of this new computing power together. We needed to employ technology that could support both 10- and 100-Mbps switched connections. Switching technology is becoming a popular networking infrastructure choice for both 10- and 100-Mbps connections. Switching technology also eases network congestion compared to the collision-based, shared-hub technology that switches are replacing.

After evaluating the choices available on the market, the only solution which met our needs was the Lattis-Switch 28115 from Bay Networks. This 16-port switch, which supports both 10- and 100-Mbps switched connections, allows up to 7 cascaded switches to be chained together for 112 connections per segment. Although this switch is not cheap (\$18,950 list), it's just the ticket for advanced network-

ing infrastructures which require both flexibility and high-speed switched connections.

UNDER CONSTRUCTION

Performing this upgrade was not easy. Since it involved tearing down



Upgrading the LAN Lab's 300 clients to 486- and Pentium-based PCs provides a solid foundation for leading-edge testing.

and building up 300 systems (upgrading many of them with new processors, memory, hard disks, and network adapters), and completely rewiring the LAN Lab, we adopted a phased approach. We tore down the network 60 nodes at a time, in an assembly-line fashion. We also made certain we had the right parts for upgrading before we began, and that we were able to test all the systems before putting them back on the network.

Once the clients were installed, we tested each network with NetBench and ServerBench as we brought it back online. We used an identical server on each network to make sure we were getting consistent, repeatable results.

THE END RESULT

Was the upgrade worth it? As a point of comparison, the maximum throughput that we were able to achieve with the old four-segment network infrastructure was approximately 40 Mbps. With the same servers, utilizing two switched 100-Mbps segments with the upgraded infrastructure yielded throughput levels up to 80 Mbps.

By experimenting with various workloads, we have determined that even higher levels of performance can be reached in this configuration. However, since application profiles do not yet warrant changing workload levels, we are not reporting those results here. But as new application types are deployed and apply themselves to the capabilities of Fast Ethernet, our test profiling will change accordingly.

In the future, we'll also be adding different client types to our tests. In addition to the 300-node PC network at ZD Labs, there is also an 80-node Macintosh network. Since NetBench supports native

DOS, Windows, and Macintosh clients, we'll expand the scope of our network testing to reflect the diversity of systems being hooked to servers both today and tomorrow.

TEST-BED FOR THE FUTURE

The new LAN Lab infrastructure will help *PC Magazine* continue to deliver unique, comprehensive, and leading-edge analysis of today's networking technologies. We'll also be able to examine emerging technologies to set the signposts for the future direction of networking. With our benchmark tests and test facilities, the results you see here will give you insights to help you make buying decisions with confidence.

American Power Conversion's UPS under its management umbrella: with an SNMP board (\$319, not included in above system price) from APC installed in the server, you can remotely reset the server or the UPS.

Dell offers a limited three-year warranty with the PowerEdge XE: parts and labor are covered for the first year; years two and three are parts only; and on-site service is covered for all three years. For an extra \$99 at the time of sale, you can upgrade the warranty to cover labor for three years. The vendor also offers a variety of Business Care Plus warranty options, which for varying prices, allow you to extend coverage further.—PRB

Dell PowerEdge XE 133-2. Direct price: \$16,174. Dell Computer Corp., Austin, TX; 800-613-3355, 512-338-4400; fax, 800-727-8320; <http://www.dell.com>. Circle 448 on reader service card.

Digital Equipment Corp.

Prioris HX 5166

The 166-MHz Pentium-powered Digital Prioris HX 5166 (\$22,784 street) is one of the most technologically advanced file servers in this roundup. A progressive system design, a bridged PCI bus that provides six PCI slots, and superb server management support through Digital's ServerWorks make the Prioris HX 5166 a machine that will ably fit the bill for most departmental file server installations. Digital markets this machine as a high-end file or low-end application server.

Digital also sells the Prioris LX line of entry-level servers, and by the time you read this, the company's server offerings will include the new ZX line of enterprise-class, four-processor Pentium servers (based initially on 133-MHz Pentium processors). A 90-MHz Pentium version of the Prioris HX received an Editors' Choice award in our June 27, 1995, departmental file server roundup ("Service with Style," page 167).

The Prioris HX's tower case is split vertically into two separate compartments. One side houses the Digital-designed motherboard, the dual-processor card (our test unit contained one proces-

sor; dual-processor configurations are also available), and eight memory slots. The motherboard shows that the Prioris HX offers a lot of expansion potential: it features a total of 12 I/O slots—six EISA and six PCI.

This motherboard's bridged PCI design supports a primary PCI bus and a secondary PCI bus, each of which holds three PCI slots. Hewlett-Packard's NetServer 5/133 LH (also reviewed here) offers a similar bridged design, but with two on-board Fast SCSI-2 adapters plus a PCI slot on the primary bus, and four PCI slots on the secondary bus. The motherboard also features integrated video.

On the other side of the Prioris HX's case are seven drive bays and a 450-watt power supply. A space is left inside the server for an optional secondary power supply (\$350, not included in above price) with a separate power input for redundancy. These power supplies together support current sharing and automatic fail-over.

All seven of the system's drives are hot-swappable and support RAID levels 0, 1, and 5 through the installed Mylex 960 Fast/Wide SCSI-2 PCI disk controller. Digital also offers the BA-350 external RAID subsystem for additional storage capacity (a \$900 option, not included in above price). For Fast Ethernet connections, the Prioris HX included two Digital DE500 PCI 100Base-T adapters.

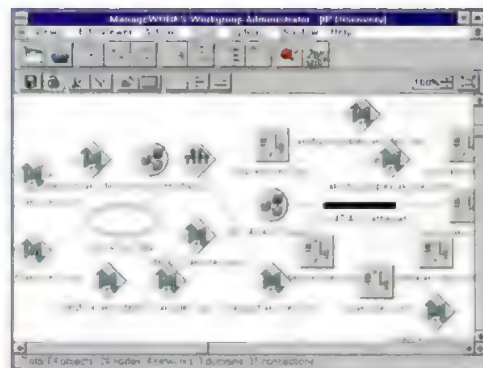
Digital takes a two-pronged approach to management for the Prioris HX: the vendor's ServerWorks software package

performs in-band functions, while the Remote Server Manager (RSM) controller board and software handle out-of-band management. ServerWorks is currently in its debut at Version 1.0.

ServerWorks' auto-discovery feature scans the network that the management station is connected to upon boot-up, and creates a map of all SNMP-enabled hardware on your network, including servers, clients, routers, hubs, and bridges (it can recognize both Digital's equipment as well as other vendors' hardware). Statistics such as processor, disk, and system memory utilization can be gathered to determine the overall health of the server. Thresholds can be configured to alert the administrator in the event of a failure via electronic mail, pager, and a log. Temperature and voltage metering capabilities are not supported in version 1.0 of Server Works (although they are supported by the RSM controller, and statistics can be displayed through ServerWorks' interface), although both features will be in the next release. ServerWorks will operate on a Windows 3.11, Windows 95, or Windows NT management station.

The Remote Server Manager (\$425 street) is an EISA board that plugs into any server that you wish to manage remotely from a central site with the RSM software. RSM statistics can be viewed through ServerWorks. Dial-in access is granted through the RSM board over a PPP connection, allowing you to monitor temperature, voltage, and external power voltage, among other features. Servers may also be remotely reset or

DIGITAL PRIORIS HX 5166



Digital's ServerWorks tracks all network devices including desktops, bridges, and routers.

SUITABILITY TO TASK

Digital Prioris HX 5166

Expandability/scalability	Excellent
Performance	Good
Security/fault tolerance	Good
Server management	Good

The Techies Want Performance.



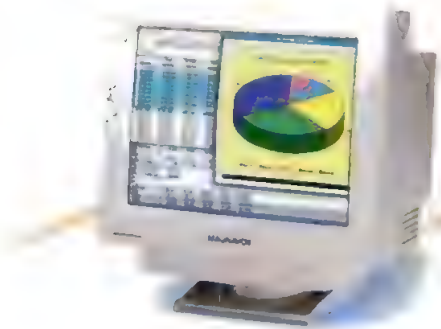
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rebooted in the event that they fail or lock up. And because the RSM board operates under its own power via an external power supply, the remote server can still be accessed even if the server has lost power. The RSM board also allows for remote floppy disk drive access and offers a dial-up feature in the event of an error. The RSM software requires that Windows NT be installed on the management station.

On our benchmark tests—despite the

Digital's Remote Server Manager board allows you to access and reboot the server remotely—even if the system has lost power.

fact that it had the fastest processor of all servers tested—the Pentium/166-based Prioris HX did not manage to outpace the front-running, Pentium/133-based performers from Compaq and Hewlett-Packard. Much of this is due to Digital's network adapters, which had a difficult time load-balancing between the two segments. The addition of a driver parameter fixed this problem under NetWare, but a similar solution was not available for Windows NT at the time of testing. Hence, the Prioris HX performed in the top tier under NetWare. Under Windows NT, however, the system's throughput matched the top performers with a full client load, although with small client loads, its throughput was the slowest of the pack.

Digital offers an optional \$4,000 rack for the Prioris line of servers that is ideal for saving space in your server room. The vendor backs this machine with a three-year limited parts-and-labor, on-site warranty. Next-business-day response is also guaranteed.—PRB

Prioris HX 5166. Street price: \$22,784. Digital Equipment Corp., Acton, MA; 800-344-4825, 508-493-5111; fax, 800-388-3228; <http://www.pc.digital.com>. Circle 449 on reader service card.

Bigger, better, and faster describes the departmental file servers in this roundup: All turned in higher benchmark test scores than any we had previously recorded.

Excellent design and implementation make the Compaq ProLiant 1500 5/133 the performance leader under both NetWare 3.12 and Windows NT Server 3.51.

What the Numbers Mean

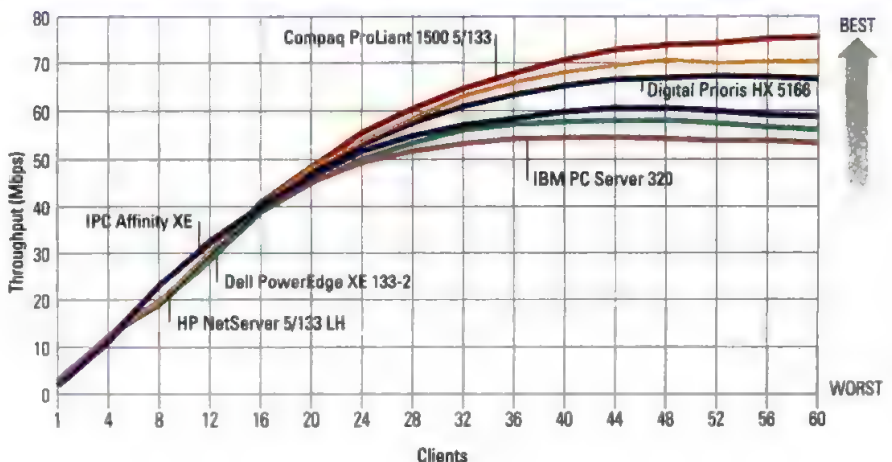
Choosing a file server for your company is never an easy task. After all, you're looking for the perfect marriage of performance, reliability, and scalability. Moreover, it's a decision you'll have to live with on a day-to-day basis for several years. You can arm yourself with the knowledge of the best ingredients—processor speeds, bus types, hard disks, and network cards—but that won't automatically translate into the best file server you can buy.

Component-level features can and do make a difference, but on the surface, these file servers exhibit more similarities than differences. All systems offered Pentium processors, dual-processing capability, 512K of L2 cache (with the exception of HP's NetServer 5/133 LH, which had a 256K L2 cache), high-speed PCI buses, PCI network adapters, and Fast or Fast/Wide SCSI-2 hard disks and adapters—all key elements for high-speed servers. However, better system performance did not necessarily stem from the highest-rated components but

rather from a well-implemented solution. Subtle hardware elements and top-notch engineering speak for the differences in test scores found here, and it is these differences that set the vendors apart and create performance factors not always found on marketing spec sheets.

While you might find the throughput offered by any of these six servers sufficient for your needs, we did find differences you'll want to consider. Our Net-Bench testing focuses on the system as a whole, as opposed to focusing on specific subsystems. In our last server roundup ("Service with Style," *PC Magazine*, June 27, 1995), low CPU utilization results revealed that our 10Base-T Ethernet network—even when divided into four segments—simply wasn't pushing the processing power of the server. We turned to Fast Ethernet (100Base-TX) to take the pressure off the infrastructure and place it back onto the server in order to gauge the servers' performances more accurately. The Total Network Throughput scores posted under NetWare for this roundup are the highest test scores we've ever

TOTAL NETWORK THROUGHPUT: NETWARE 3.12



reported for file server throughput. In fact, the 75-Mbps peak throughput garnered by the ProLiant 1500 effectively doubled prior top results.

Under workloads of up to 20 NetBench clients, performance proved to be similar; however, as the workload increased, the results divided the products into two distinct groups. The ProLiant 1500, HP NetServer 5/133 LH, and Digital Prioris HX 5166 represented the upper tier, while the IPC Affinity XE, Dell PowerEdge XE 133-2, and IBM PC Server 320 made up the second tier.

Unique to the ProLiant 1500 is Compaq's proprietary TriFlex/PCI system architecture, which has a Compaq-designed core-logic chip set. All other servers in this roundup used Intel's Neptune chip set. These chip sets are responsible for communication between the Pentium processor, system memory, and PCI peripherals. The TriFlex/PCI chip set, like the Neptune chip set, supports write-back secondary processor cache. But Compaq's TriFlex/PCI design differs because the chip set supports two-way set-associative cache—as opposed to the Neptune chip set, which supports only direct-mapped cache. Set-associative cache permits more effective mapping of memory locations into cache locations (in the case of two-way set-associative, each memory location can be cached into two separate cache locations) and reduces an effect known as cache thrashing. Thus it increases the cache hit ratio, which results in better

performance compared with direct-mapped cache. Set-associative cache is more expensive to implement than direct mapped, but it provides slightly better overall system performance.

No longer bottlenecked by the network wire, we were able to evaluate system integration of the processor, cache, memory, and I/O subsystems. Two servers here—the Pentium/90-based IBM PC Server 320 and the Pentium/120-powered IPC Affinity XE—simply did not have the horsepower to keep pace with the Compaq and HP servers, both packing 133-MHz Pentiums. Besides slower processor clock speeds, the IBM and IPC machines are limited to a 60-MHz system bus, which provides 10 percent less bandwidth than the 66-MHz bus supported by the 133-MHz CPU.

Processor speed, however, is not the only indicator of good performance. The Digital Prioris HX contained a 166-MHz Pentium CPU, but like the IPC entry, it deployed a slower asynchronous L2 cache. Synchronous cache used by the other servers permits faster burst timings than asynchronous cache, which reduces wait states.

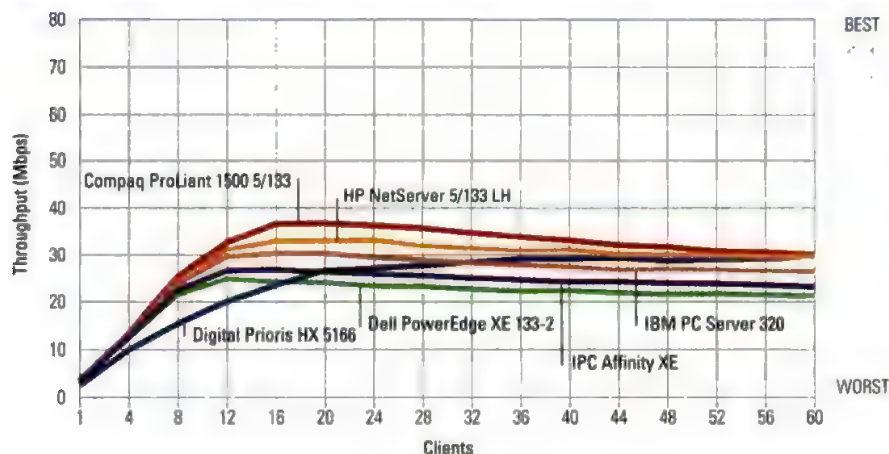
Processor performance can always be squandered by poor or slow system design or peripherals. The PCI bus (offered in all these systems) enjoys a number of benefits over EISA, previously the bus of choice in servers. Comparative transfer rates of 132 MBps for PCI (theoretical) and 33 MBps for EISA make speed one obvious benefit; low CPU utilization by PCI adapters is another.

Dell opted to use its EISA-based Dell SCSI Array disk controller card over the PowerEdge's integrated PCI SCSI connector. The vendor's choice of network card—the 3Com 3C590 Fast EtherLink PCI adapter—also affected the server's performance test results. This NIC produces high CPU utilization, which slows down overall system performance. Comparatively, the HP and IPC entries both came equipped with Cogent's EM110 TX PCI Ethernet adapter, which provides a winning combination of low CPU utilization and high throughput.

Generally, the slowest component in the server is the disk subsystem. Performance gains can be realized by using Fast/Wide SCSI-2 hard disks and adapters, which offer a wider 16-bit data path and faster 20-Mbps transfer rate than standard Fast SCSI-2. The servers we tested all used Fast/Wide disk subsystems, with the exception of the HP NetServer LH's integrated Fast SCSI-2-only adapters and the Dell PowerEdge's narrow drives. The performance of these devices is less visible under NetBench, which mainly uses smaller random transfers as opposed to the large sequential chunks of data required to stress the disk subsystem fully, especially a fully Fast/Wide disk subsystem.

Besides testing under NetWare 3.12, we tested each server under Windows NT Server 3.51 to see if hardware optimizations yield varying results for the different NOSs. Overall, these servers performed about half as fast under Windows NT (see the sidebar "The Rest of the Story"). The fastest server in both NOS environments was the ProLiant 1500, but its peak throughput under Windows NT was almost exactly half its peak throughput under NetWare. While performance continued to increase as the workstation load increased on the ProLiant 1500 under NetWare, performance peaked at 20 clients under Windows NT. This disparity probably exists for two reasons. First, NetWare's memory management design is more streamlined than Windows NT's: It lacks a complex internal messaging and protection architecture, and its data transfer path between the disk, memory, and NIC subsystems is better optimized.

TOTAL NETWORK THROUGHPUT: WINDOWS NT SERVER 3.51



Second, the servers' hard disk and NIC drivers may not be as well-tuned under Windows NT as under NetWare, given the maturity of the latter OS relative to the former. The servers' relative rankings are the same for each OS with the exception of IBM PC Server 320, which finished last using NetWare but moved up to fourth under Windows NT.

In additional testing using NetBench's NIC Throughput test, we found that the IBM 10/100 PCI Ethernet adapter yielded the fastest throughput of any server adapter under NetWare. This card is actually Intel's EtherExpress PRO/100B (which IBM licenses from Intel), a recent Editors' Choice in our roundup of Fast Ethernet adapters ("Shifting into High Gear," *PC Magazine*, December 19, 1995). Further discussions with Intel relating to this NIC revealed that Intel's highly optimized driver set for Windows NT offers even greater performance gains over NetWare execution.

The Digital Prioris HX, though sustaining good scores at higher client loads, performed erratically during testing. Initial testing with NetWare required the addition of driver parameters for balanced service between the system's two Digital DE500 PCI network cards. A similar solution was not available for the Windows NT driver, and investigation of individual client numbers showed one of our two Ethernet segment's clients producing little to no throughput.

—Analysis written by Jeffrey G. Witt

How We Tested

We exercised our newly upgraded PC Magazine LAN Labs to test these departmental file servers. The new network design features Fast Ethernet signaling speeds as well as high-powered network clients. We measured performance under both NetWare 3.12 and Windows NT Server 3.51 network operating systems (NOS) by attaching each server to a 60-node network. We required each vendor to provide two Fast Ethernet 100Base-TX

network interface cards (NICs) in order to divide the network into two identical 30-client segments. Fast Ethernet and the segmentation were deployed to ensure that our tests were not wirebound.

The network's client PCs represent a change in the client mix that we've used in previous roundups. The clients now contain more powerful processors, including Pentiums with PCI buses. Each network segment consisted of 20 486DX2/66- and 10 Pentium/133-based PCs. Each client was configured with a 100Base-TX Ethernet adapter, and network connections to the server were made through four Bay Networks' LattisSwitch 28115 Ethernet switching hubs.

The Disk Mix portion of our NetBench 4.0 benchmark test suite measures the server's I/O performance for **Total Network Throughput**. As the name Disk Mix implies, the test suite performs a number of network file manipulations, including opening, closing, creation and deletion of files, and data reads and writes, as well as directory changes. Shared as well as private directories and files are part of the test to simulate server environments further.

The network file operations of Disk Mix are based on a profile of eight market-leading applications. The profiles were turned into a script for the NetBench clients to play back while testing the server, reading and writing binary and text files at various block sizes. It's unlikely that your network clients will pound the server at the same sustained rates as NetBench, so you should consider these workloads as very intensive for each client station.

We required each system to contain 128MB of ECC memory and four 2GB hard disks. The hard disks were attached through a single channel on each subsystem controller. Each vendor was asked to provide its latest drivers for the NICs and disk controllers for both NetWare and Windows NT. The hard disks were striped (RAID 0) into one logical volume via the NOS.

For the NetWare 3.12 configurations, we formatted the hard disks with a 16K block size and tuned each server using SET parameters to optimize for NetBench. Both Digital and Hewlett-Packard asked us to install NetWare's 312PT6 system patch for their servers. For Windows NT, we formatted each hard disk with the NTFS file system and loaded Microsoft's Service Pack 2 for optimal performance. NetBench DOS client software was used for each NOS, using NetWare VLM 1.2 and Windows NT's NWLink.

Hewlett-Packard Co.

HP NetServer 5/133 LH



Form meets function in the HP NetServer 5/133 LH from Hewlett-Packard Co. (\$16,989 street price, not including monitor), the recipient of our Editors' Choice award in this roundup. This server is built from the ground up to be an all-in-one solution for the file server needs of your company's medium-size workgroups. From its 133-MHz Pentium processor to its advanced, bridged PCI architecture, the NetServer 5/133 LH offers one of the most unique arrays of features of all the servers in this roundup.

This system also includes a well-rounded and useful server management package in HP's NetServer Navigator CD,

which features HP's NetServer Assistant 2.2 and OpenView for Windows. The NetServer 5/133 LH also delivers on performance: It was consistently near the top of the charts on our benchmark tests, under both Windows NT and NetWare operating environments. HP also sells the NetServer LS series of high-end application servers and the NetServer LC server series, designed for small workgroups.

The NetServer 5/133 LH's casing highlights Hewlett-Packard's experience with server system design: It features two integrated PCI Fast SCSI connections that support disk duplexing right out of the box, a capability unique to the NetServer 5/133 LH. The system also has six hot-swappable Fast/Wide SCSI-2 drive bays that can be configured with an optional PCI Dual-Channel Fast and Wide

SCSI Array Controller Adapter if you wish to set up your disk subsystem in a RAID array (this option is priced at \$2,250 separately or \$2,000 if purchased at the same time as the server).

In our test system, HP installed four 2GB Seagate Barracuda Fast/Wide SCSI-2 hard disks. The system has three additional front-accessible drive bays, two of which accommodate the floppy disk drive and a Sony SCSI CD-ROM drive.

The internal design of the NetServer 5/133 LH further accentuates the vendor's emphases on design, functionality, and ease of use. The HP motherboard features a bridged PCI bus architecture utilizing a Digital PCI bridge chip set. The primary PCI bus incorporates the two Adaptec Fast SCSI-2 adapters and one standard PCI slot. The secondary PCI bus

SUITABILITY TO TASK

HP NetServer 5/133 LH

Expandability/scalability	Good
Performance	Good
Security/fault tolerance	Excellent
Server management	Excellent

incorporates four more PCI slots, one of which is shared with an EISA slot. Four additional EISA slots are also available. Two of the PCI slots were taken by Cogent EM110 TX Ethernet NICs.

The NetServer 5/133 LH's 133-MHz Pentium CPU is located on a card that resides in a proprietary slot on the motherboard. This card also contains the unit's six memory slots (which can hold a maximum of 192MB of RAM using 32MB memory modules), and 256K of synchronous secondary processor cache.

The NetServer 5/133 LH does support symmetric multiprocessing, but you must purchase another processor card. A dual 100-MHz Pentium card with 512K of shared secondary processor cache is priced at \$1,530 (street); a dual Pentium/133 configuration, though planned, is not currently available.

In addition to hot-swappable hard disks, ECC memory is a standard feature of the NetServer 5/133 LH. Other fault-tolerant and security features include an integrated thermal monitoring device (which will notify the network administrator of excessive system temperatures locally, or via e-mail or pager) and a single lock on the front of the case to safeguard the system's six drive bays.

HP offers some additional security for the NetServer 5/133 LH in the form of the Remote Assistant, an EISA card that is capable of notifying the network administrator (via e-mail or pager) of problems ranging from excessive internal temperatures to hard disk failures because it has its own processor, a separate power source (battery), and a modem. This de-

SUMMARY OF FEATURES

Departmental File Servers

Price of tested configuration (with 128MB of ECC RAM) We report prices for the servers configured as we tested them, with pricing for server management software and network cards included (monitor pricing is not included). However, the price of NetWare 3.12 and Windows NT Server 3.51 is not included. To estimate the price of a 100-user NetWare or NT Server license, add approximately \$4,000 to the cost of the server.

RAID levels supported by disk controller Depending on the configuration, or level, of RAID (Redundant Array of Inexpensive Disks) used, different combinations of data-security and data-speed features can be built into the hard disk subsystem. Some of these features include disk mirroring, parity checking, and data striping. The RAID implementation can be handled by hardware, software or both.

Hot-swappable hard disks If the tested configuration supports hot swapping, you can replace a failed drive without shutting down the server.

Asset management, network management, and fault-tracking These entries indicate whether the server's included management software solution allows you to manage assets such as system temperature, status of installed hard disks, and CPU utilization, network components (including client workstation status), and whether you can choose to be alerted when certain events occur, such as hard disk malfunctions and system overheating.

Hardware/NOS setup software This indicates whether a given server comes with setup software to help you configure your server's hardware and system drivers for a particular operating system, for example, or set and optimize network connections.

vice costs an additional \$900 (not included in above price), and it is well worth the price, as it allows the administrator to manage the server from remote locations, even if the power is out.

On our benchmark tests, the NetServer 5/133 LH was a consistently strong performer under both NetWare and Windows NT. Compared to other servers in this roundup, only the Compaq ProLiant 1500 outpaced HP's entry, and only by a very thin margin. Under NetWare, the NetServer 5/133 LH's throughput increased steadily as clients were added, then leveled off at approximately 48 clients. Running Windows NT, the NetServer 5/133 LH reached

a peak throughput level at 24 clients, but maintained a consistent throughput level up to the full 60-client load.

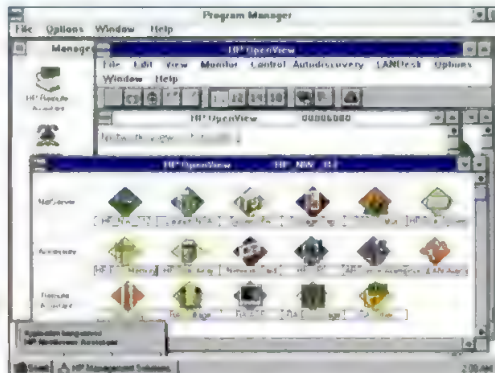
To manage the NetServer 5/133 LH, HP includes its NetServer Navigator CD-ROM, which consists of NetServer Assistant 2.2, HP OpenView for Windows, and HP Configuration Assistant. NetServer Assistant monitors and manages servers not only from within the HP OpenView environment, but also from any third-party management packages based on the OpenView network management platform. Installation of this and the other Windows-based programs on the NetServer CD was simple and straightforward.

NetServer Assistant's monitoring features include logs of both processor and disk activities, as well as an inventory of devices across the network, including desktop machines and printers. The software's remote-notification features cover all the bases, including e-mail and paging capabilities.

Hewlett-Packard supports the NetServer 5/133 LH with a three-year, on-site warranty. Next-business-day response is also included.—William P. Flanagan

HP NetServer 5/133 LH. Street price: \$16,989. Hewlett-Packard Co., Network Server Division, Santa Clara, CA; 800-322-4772; fax, 800-333-1917; <http://www.hp.com/go/net-server>. Circle 450 on reader service card.

HP NETSERVER 5/133 LH



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CIRCLE 001 ON READER SERVICE CARD

SUMMARY OF FEATURES

Departmental File Servers



■ YES ■ NO

Products listed in alphabetical order

	Compaq ProLiant 1500 5/133	Dell PowerEdge XE 133-2	Digital Priors HX 5166	HP NetServer 5/133 LH	IBM PC Server 320	IPC Affinity XE
Price of tested configuration (with 128MB ECC RAM)	\$17,599 (street)	\$16,174 (direct)	\$22,784 (street)	\$16,989 (street)	\$18,134 (list)	\$17,144 (street)
Processor	Pentium/133	Pentium/133	Pentium/166	Pentium/133	Pentium/90	Pentium/120
Maximum number of CPUs supported	2	2	2	1 (optional dual-processor board)	2	2
Installable system ECC RAM	256MB	256MB*	192MB	192MB	256MB	256MB*
Installed/maximum external RAM cache	512K, 512K	512K, 512K	256K, 512K	256K, 256K	512K, 512K	512K, 512K
Type of external RAM cache	Synchronous	Synchronous	Asynchronous	Synchronous	Synchronous	Asynchronous
Motherboard manufacturer	Compaq	Intel	Digital	HP	IBM/Micronics	AMI
Chip set manufacturer and model	Compaq Flex/SMP	Intel Neptune	Intel Neptune	Intel Neptune	Intel Neptune	Intel Neptune
Network interface cards (and interface)	Two Compaq NetFlex-3/P (PCI)	Two 3Com 3C590 (PCI)	Two Digital DE500 (PCI)	Two Cogent EM110 TX (PCI)	Two IBM PCI 10/100 (PCI)	Two Cogent EM110 TX (PCI)
Disk Subsystem						
Hard disk manufacturer and model	Seagate Barracuda ST32250W	Seagate Barracuda ST32550N	Seagate Barracuda ST32550W	Seagate Barracuda ST32550WC	Quantum Atlas XP32150W	Conner CFP2107E
Installed hard disks	Four 2GB Fast/Wide SCSI-2	Four 2GB SCSI-2	Four 2.1GB Fast/Wide SCSI-2	Four 2GB Fast/Wide SCSI-2	Four 2GB Fast/Wide SCSI-2	Four 2GB Fast/Wide SCSI-2
Hard disk controller (and interface)	Integrated (PCI)	Dell SCSI Array (EISA)	Mylex 960 (PCI)	Two Adaptec 7850s (integrated)	Adaptec AHA-2940w (PCI)	Mylex 960 (PCI)
Disk controller hardware cache	512K	1MB	4MB	None	None	4MB
RAID levels supported by disk controller	0, 1, 4, 5	0, 1, 4, 5	0, 1, 5	None	0, 1, 5	0, 1, 5
Expandability						
Number of SIMM sockets in use	4	4	4	4	4	4
Total number of SIMM sockets	8	8	8	8	8	8
Expansion bus slots	5 EISA, 2 PCI, 1 PCI/EISA	7 EISA, 1 PCI, 1 PCI/EISA	6 EISA, 6 PCI	4 EISA, 4 PCI, 1 PCI/EISA	5 EISA, 3 PCI, 1 PCI/EISA	5 EISA, 3 PCI, 1 PCI/EISA
Accessible drive bays (3.5", 5.25")	0, 8	0, 4	0, 9	0, 9	0, 8	13, 4
Internal drive bays (3.5", 5.25")	0, 0	0, 0	0, 0	0, 0	2, 0	0, 0
SCSI controllers (and interface)	1 (PCI)	1 (EISA)	1 (PCI)	2 (PCI)	1 (PCI)	1 (PCI)
Power supplies	One 325W	Two 300W	One 450W	One 350W	One 300W	One 500W
Security and Fault Tolerance						
Hot-swappable hard disks	5	8	7	6	None	12
Lockable hard disk subsystem	■	■	■	■	■	■
Lock for power button	■	■	■	■	■	■
Lock for reset button	N/A	■	■	■	■	■
Lock for front panel	■	■	■	■	■	■
Lock for case	■	■	■	■	■	■
Temperature sensor location	Motherboard	Motherboard	RSM board	Motherboard	N/A	Power supply
Server Management						
Included server management software	Insight Manager 2.4	SafeSite 2.2	ServerWorks 1.0	NetServer Navigator	ServerGuide 2.3	Affinity Server Management 1.0
Modem manufacturer and speed	N/A	N/A	Zoom 14.4-Kbps	N/A	N/A	N/A
Asset management	■	■	■	■	■	■
Network management	■	■	■	■	■	■
Fault tracking	■	■	■	■	■	■
Local alerts via console/audible alarm	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Remote alerts via pager	■	■	■	■	■	■
Remote alerts via modem	■	■	■	■	■	■
Remote alert via SNMP	■	■	■	■	■	■
Remote reboot	■	■	■	■	■	■
Hardware setup software	■	■	■	■	■	■
NOS setup software	■	■	■	■	■	■
Service and Support						
24-hour, 7-day live technical support	■	■	■	■	■	■
Standard warranty on parts/labor	3 years/3 years	3 years/1 year	3 years/3 years	3 years/3 years	3 years/3 years	3 years/3 years
On-site service charge	Included (3 years)	Included (3 years)	Included (3 years)	Included (3 years)	Included (3 years)	Included (1 year)

* This system can support up to 512MB of standard DRAM.
N/A—Not applicable. The product does not have this feature.



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PCs

Departmental File Servers

IBM Corp.

IBM PC Server 320

The Pentium/90-based IBM PC Server 320 (\$18,134 list price, not including monitor) is unfortunately more akin to a high-end workstation than to a server. The system's fault-tolerance features are severely limited compared to the competition, and its performance was comparatively weak. However, IBM's Net-Finity server management software is rated as one of the best packages in this roundup. IBM aims this server at departmental LAN installations within larger corporations or small businesses for file server applications.

IBM offers a variety of servers in this line in both PCI/EISA and PCI/Micro-

SUITABILITY TO TASK

IBM PC Server 320

Expandability/ scalability	Fair
Performance	Fair
Security/ fault tolerance	Poor
Server management	Good

Channel configurations. IBM also sells the PC Server 310, a PCI/ISA mini-tower system for small businesses; the PC Server 500 line of high-end file or low-end applica-

tion servers available in both PCI/EISA and PCI/MCA configurations; and the PC Server 720 line of high-end application servers, which support up to six processors but are available only in PCI/MCA configurations.

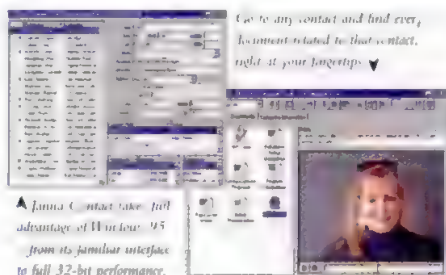
The PC Server 320's case design offers few of the advantages of a state-of-the-art file server. None of the system's eight front-accessible 5.25-inch drive bays are hot swappable, making the PC Server 320 the only system in this roundup without this feature, and an unlikely candidate for RAID configurations (the PC Server 520 offers hot-swappable drives and RAID support standard). There were four 2GB Quantum Atlas Fast/Wide SCSI-2 hard disks installed in the system, connected to a PCI-based Adaptec Fast/Wide SCSI-2 disk controller. Two Intel EtherExpress PRO 100B PCI network adapters (licensed by IBM) provide 10Base-T or Fast Ethernet connections.

Internally, the system is limited as well. Three of the PC Server 320's PCI slots were used by the disk controller and the two network cards. One of the system's EISA slots is taken by a video adapter,



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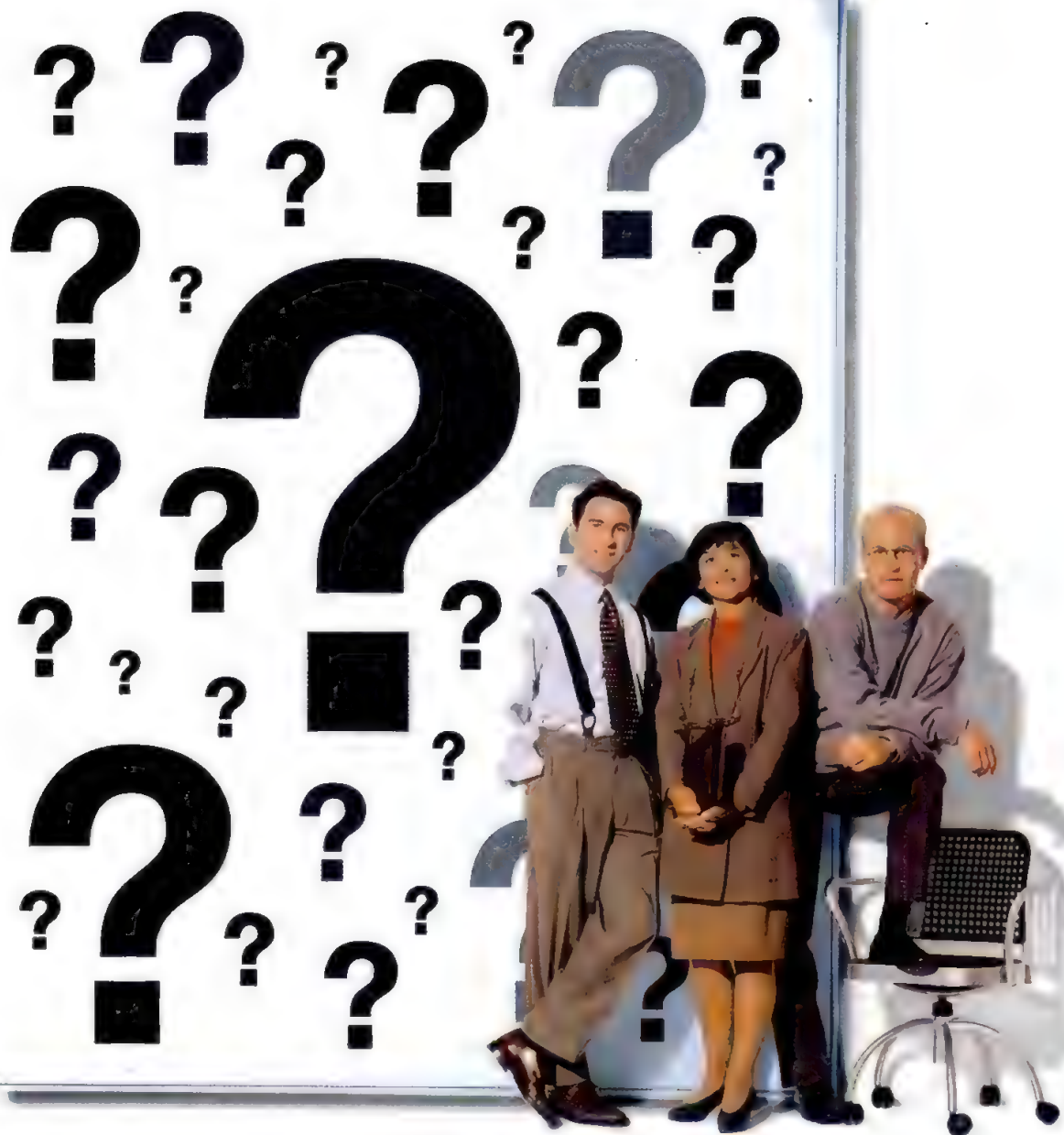
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CIRCLE 383 ON READER SERVICE CARD



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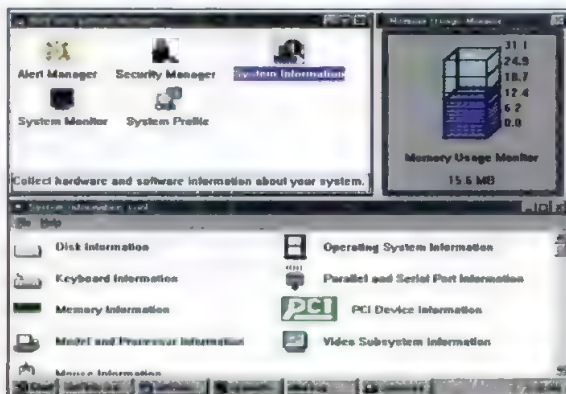
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Departmental File Servers

IBM PC SERVER 320



IBM's NetFinity gathers both hardware and OS information.

and three of the slots are blocked by the processor sockets, and are unable to take full-length expansion cards. The motherboard has two processor sockets, one of which was used for the installed 90-MHz Pentium CPU, which was backed by 512K of L2 cache. The system does feature eight SIMM sockets, which can accommodate a maximum of 256MB of ECC memory.

The unit's security features included a lock on the front of the case to prevent access to the drive bays and the power switch, as well as password protection and keyboardless operation. The vendor also sells a lock for the server's back panel to prevent unauthorized system accesses (a \$39 option, not included in the above price). The PC Server 320's fault-tolerance features, however, aren't sufficient for departmental needs. The installed Adaptec disk controller will only allow mirroring of the disk subsystem; an additional controller is needed for duplexing.

IBM included the popular APC Power Chute Plus software package to run with NetFinity. Utilizing Power Chute Plus will of course require purchasing an APC UPS for protection against power outages. The PC Server 320 also does not provide any thermal monitoring capabilities, either through hardware or software.

In terms of server management, IBM's ServerGuide CD is among the best available. ServerGuide, Version 2.4, supports the installation of NetWare (Versions 3.12 and 4.1), SCO Open Server Enterprise 3.0, OS/2 2.11 for SMP, and OS/2 Warp, Version 3.0. ServerGuide enables the installation of these operating systems and facilitates loading of device drivers, and also includes all of the PC Server 320's online documentation.

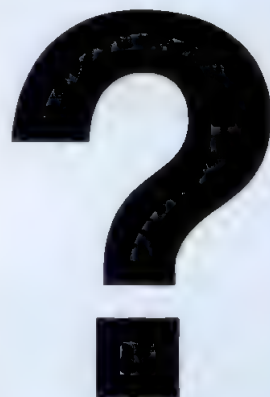
ServerGuide also contains NetFinity, IBM's PC server system management software. NetFinity provides asset management, system and performance monitoring, and problem notification of networked PCs. It also works with all types of hardware and software, providing multiplatform support for IBM desktop and mobile PCs as well as other manufacturers' products. NetFinity further features a remote DMI browser; SNMP support; and it

also supports predictive failure analysis, which will warn you in advance when a hard disk is about to fail. A client version of NetFinity comes preloaded on the vendor's PC 300 and PC 700 desktop systems, as well as ThinkPad notebooks.

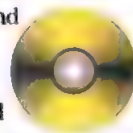
On our benchmark tests under NetWare, the system was the slowest performer of the group. It reached its highest throughput level at 44 clients; however, this pales in comparison to the front-

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running Compaq ProLiant 1500, which surpassed this throughput level at 24 clients and kept rising.

Under Windows NT, the system's performance was slightly better compared with other servers. The PC Server 320's throughput topped out at about 16 clients, and then gradually declined as more clients were added. Under small client loads, the PC Server 320 kept pace well with the top-performing Compaq and HP machines.

The PC Server 320's performance was partially hindered by its 90-MHz

Pentium CPU: most other machines here ran on 133-MHz Pentiums. Not only is the processor slower, but the system bus is slower as well—60 MHz, as compared with the Pentium/133-based servers' 66-MHz bus. This disparity in bus speed affects overall system performance.

The PC Server 320 is backed by a three-year warranty which covers parts, labor, and on-site service with 24-hour response. The vendor also offers 24-hour, 7-day, toll-free telephone technical support.—WPF

IBM PC Server 320. List price: \$18,134. IBM Corp., Somers, NY. 800-426-3333; fax, 800-426-4329; <http://www.pc.ibm.com/servers>. Circle 451 on reader service card.

IPC Technologies Inc.

Affinity XE

The Affinity XE server from IPC Technologies offers a high level of fault tolerance and the most storage space of any system in this roundup. However, this server's lackluster performance and the immaturity of the compa-

The Pentium Pro: Big-League Processing Muscle

By Carol Venezia

The times, they are a-changin'. In past server reviews, we found that the biggest bottlenecks standing in the way of great server performance occurred in the hard disks and in the network cards—CPU power was of no great concern. But that fact is no longer true, and for one simple reason: Client applications—specifically networked applications—are more prevalent and more demanding of the server's processing power than ever before. Also, the use of faster disk subsystems and 100-Mbps Ethernet segments has shifted some of the performance bottleneck back to the CPU/memory subsystem. Clients running Windows, OS/2, and Windows NT continue to access servers for file data at an increasing rate. Even the simple act of searching for a file can eat up thousands of CPU clock cycles if the file you're looking for resides on the server. And with new networking technologies such as Fast Ethernet, those requests are hitting the server at break-neck speeds.

The answer to this dilemma is not to skimp on the processor when purchasing a new file server. With Pentium speeds now reaching record highs of 150 and 166 MHz, there are plenty of powerful CPU choices available. But if your network-server processing needs require more muscle than even the Pentium can deliver—for programs such as intensive client/server applications—the answer may be the Pentium Pro.

SERVING APPS AT 200 MHZ

The Pentium Pro debuted in November 1995 in two flavors: a workstation version, with 256K of on-board processor cache, and a server version, with 512K of L2 cache. In its server implementation, Intel is positioning the Pentium Pro as a CPU for high-end systems, including application servers and Web servers. The Pentium Pro's raw speed, multifunction supporting chip set, and superior price/performance ratio make it an ideal candidate for high-end-application server platforms, a market that in the past has been dominated by Unix machines.

The Pentium Pro offers significant new design features that provide performance enhancements beyond those of the Pentium. These features include a built-in L2 cache, an internal dynamic execution engine that is optimized for true 32-bit applications and operating systems, a high-performance external bus, and glueless four-way symmetric multiprocessing capability. The Pentium Pro was designed with 32-bit operating systems and applications in mind and, as such, will outperform the Pentium when running 32-bit network operating systems including NetWare, Windows NT Server, and OS/2 LAN Server.

Unlike the Pentium, which is a single-chip design that must rely on off-board L2 cache, the Pentium Pro utilizes a dual-cavity package that includes the processor chip and the L2

cache chip. On the up side, this design allows for much speedier and more efficient cache access than the Pentium's design, simply because the physical distance between the CPU and the cache is much shorter and the cache can be accessed at CPU speed, not the slower external bus speed. This large cache will be particularly useful in multiprocessing systems, where software performance across multiple CPUs is a critical design factor.

On the downside, however, this dual-chip package is inherently expensive to manufacture. Although both the 166- and 200-MHz server-version Pentium Pro CPUs are manufactured on a 0.35-micron, BiCMOS process (a die shrink from the first-available, 0.5-micron, 150-MHz part), the complexity of integrating this chip along with the L2 cache chip is staggering. And the L2 chip itself is no small piece of hardware: The 512K part, at 31 million transistors, is significantly larger than the 5-million-transistor CPU. This partly explains why, in 1,000-unit quantities, the server-version Pentium Pros sell for \$1,319 and \$1,528 each for the 166- and 200-MHz versions, respectively.

THE 450GX PCISSET

The server version of the Pentium Pro's supporting chip set, the 450GX PCISet (code-named Orion), offers a few enhancements of its own to

ny's just-released server management solution may limit the appeal of this \$17,144 machine. The Affinity XE is designed and marketed as a midrange file server, suited for groups of 100 to 250 users. IPC also offers the Affinity XR single-processor server series for small workgroups, and expects to ship high-end Affinity XE Pro Pentium Pro-based servers (in 150-, 166-, and 200-MHz configurations) by the time you read this.

The Affinity XE's case features twelve front-accessible, hot-swappable drive bays, in addition to four 5.25-inch

bays, and one 3.5-inch bay for other devices such as a tape backup unit. In the system we tested, the vendor installed four 2GB Fast/Wide SCSI-2 Conner Filepro Performance hard disks, hooked to a PCI-based Mylex DAC 960 three-channel Fast/Wide disk controller with 4MB of hardware cache (upgradable to 32MB).

The unit we tested utilizes a 120-MHz Pentium CPU with 512K of asynchronous secondary processor cache. The system's AMI motherboard features a second processor socket, in the event

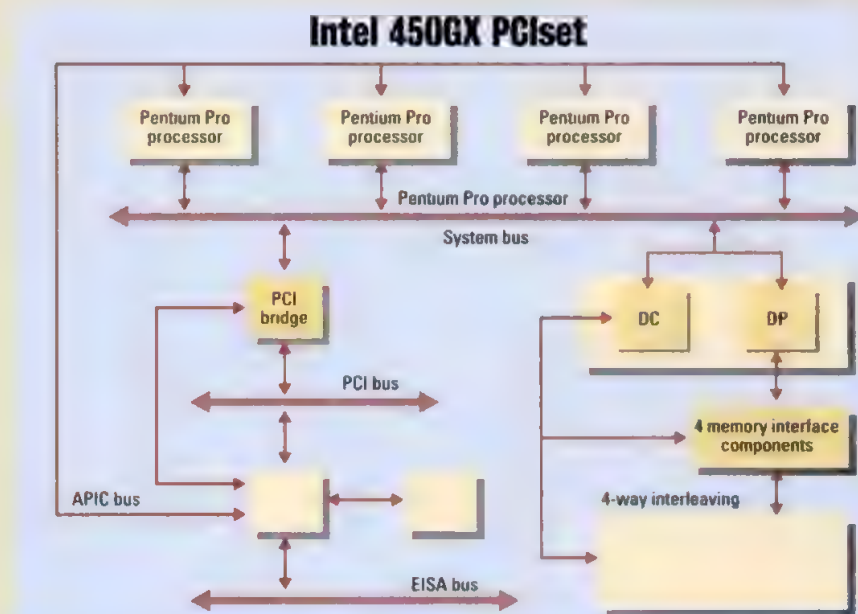
that you want to upgrade to a dual-processor configuration (a second 120-MHz CPU is an additional \$450). The eight integrated SIMM banks allow system memory to be expanded up to 512MB, using 64MB memory modules. There are three PCI slots, five EISA slots, and one PCI/EISA slot, all of which are bus-mastering. Three of the PCI slots are used—two by Cogent EM110 TX PCI 100Base-TX Ethernet adapters, and the third by the Mylex disk-controller board. (By the time you read this, the vendor will have servers

aid server-system designers. Built on a 0.5-micron CMOS process, the 450GX PCIsset actually contains five chips: one PCI bridge chip and a four-chip memory controller. This chip set will also support up to four processors.

PCI'S SIX-SLOT FUTURE

One of the 450GX's most exciting features from a system designer's perspective is its PCI bridge chip, which will allow for two PCI bridges. Because a single PCI bus can only handle a maximum of ten electrical loads, the majority of servers on the market today only have three, or at most four, PCI slots (two notable exceptions are Digital Equipment Corp.'s Prioris HX 5166 and Hewlett-Packard's NetServer 5/133 LH, both reviewed in this roundup). This is because each PCI slot appears as two electrical loads, one for the card and one for the connector. So at four slots, the bus is effectively maxed out.

The only way to expand the PCI bus beyond its 10-electrical-load limit (and thus create more PCI slots) is to create secondary, electrically isolated PCI buses. With the 450GX's PCI bridge chip, this scenario is possible. Motherboard manufacturers (including Intel) are currently building boards that take advantage of this bridge chip, and the fruits of their labor should culminate in the release



of systems with six or more PCI slots in the second half of this year.

MEMORY SUPPORT UP TO 4GB

The 450GX PCIsset's four memory controllers support up to 1GB of DRAM each for a total system memory capacity of 4GB. System designers can also take advantage of the 450GX chip set's support for error correction-code (ECC) DRAM, as well as its built-in ECC protection for the data bus. In the past, designers had to incorporate an additional controller chip and circuitry to support ECC DRAM, which not only uses board real estate, but also adds hundreds of dollars to system costs. But

with this new chip set, ECC memory-control support is essentially free.

THE FUTURE

As you read this, numerous system vendors are gearing up for the introduction of Pentium Pro servers that employ up to four processors. These systems will most likely be available by the end of the second quarter, after the release of the 200-MHz Pentium Pro with 512K L2 cache in May. By the end of the year, the Pentium Pro should take the server market by storm as new chips are introduced, pricing drops, and motherboards are available from Intel and others.

Microsoft File and Print Services for NetWare

By Steve Rigney

Many network administrators tend to forget that upgrading a network operating system requires several steps and two major costs. The first cost is the price of the NOS software itself. The second—and often overlooked—cost is the time and effort involved in changing all of your client PCs. For example, Novell's NetWare uses DOS-based drivers on client PCs, but Windows NT Server requires Windows for Workgroups or Windows NT on every client. If you have several hundred DOS-based NetWare clients, the benefits of upgrading to a new NOS such as Windows NT may be outweighed by the cost of reconfiguring all of your clients. Fortunately, Microsoft has developed a solution that will allow you to use your existing NetWare clients to access a Windows NT server on your network.

Microsoft's File and Print Services for NetWare (FPNW), which runs as a 32-bit system service on servers running Windows NT, emulates a NetWare 3.12 server. Because FPNW runs in the background it does not require a lot of system resources and as a 32-bit service, it will work side by side with your other Windows NT network services. Unfortunately, you can't run your existing NetWare loadable modules (NLMs) on your Windows NT server, and you will also lose some performance.

INSTALLATION

To install FPNW, you simply select the "Add New Software" option in the network section of the Control Panel. After the service is installed, you can use File Manager to configure your hard disks and printers as NetWare resources. When you select a hard disk to become a NetWare volume, FPNW creates a SYSVOL directory on the disk and copies standard NetWare files—including Login, Logout, Map, Slist, and Attach—to the drive. You

can create as many NetWare volumes as you choose, depending on the number of hard disks on your server.

After you have installed the service and created your NetWare resources, you are ready to configure your users. You can use your existing Windows NT user information, or you can use the Migration Tool for NetWare that comes with FPNW to import the Bindery information from an existing NetWare 3.x server.

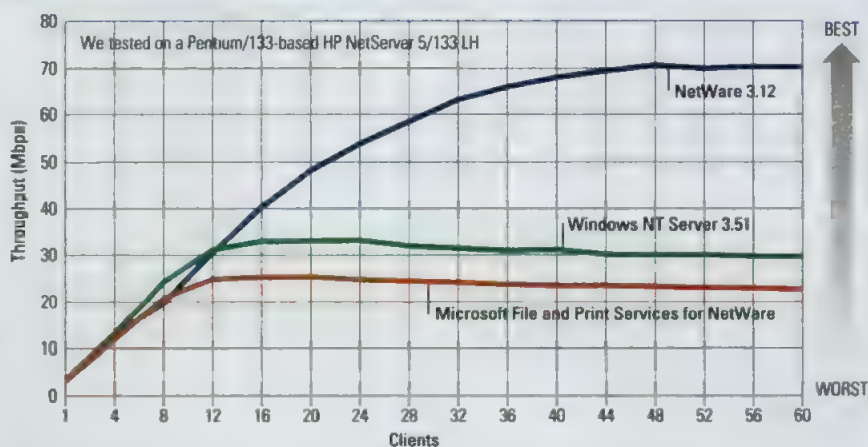
The fastest way to add a few users is to use the NET User utility to grant FPNW rights to your existing Windows NT users. However, if you are adding a

and security information, you can start connecting your NetWare clients. Fortunately, FPNW will work with any NetWare client software, including the Netx and VLM requesters, so you will not have to make any changes on the client side. You can also use all of the same NetWare utilities, such as Syscon, Pconsole, and Fconsole.

PERFORMANCE HIT

To test the performance of FPNW, we installed it on our Editors' Choice, the HP NetServer 5/133 LH. We connected 60 client PCs, then used NetBench

FPNW PERFORMANCE VS. WINDOWS NT AND NETWARE



new Windows NT server to your existing NetWare network, you will probably want to stick with the Migration tool. The FPNW Migration Tool Version 1.1 will automatically search for any existing NetWare servers on your LAN and give you the option to import user names, passwords, account restrictions, and even personal login scripts. Unfortunately, FPNW cannot import the NetWare Directory Services information from your NetWare 4.x file servers. You also have to store the imported Bindery information on a hard disk formatted with Windows NT File System.

ACCESSING THE NETWORK

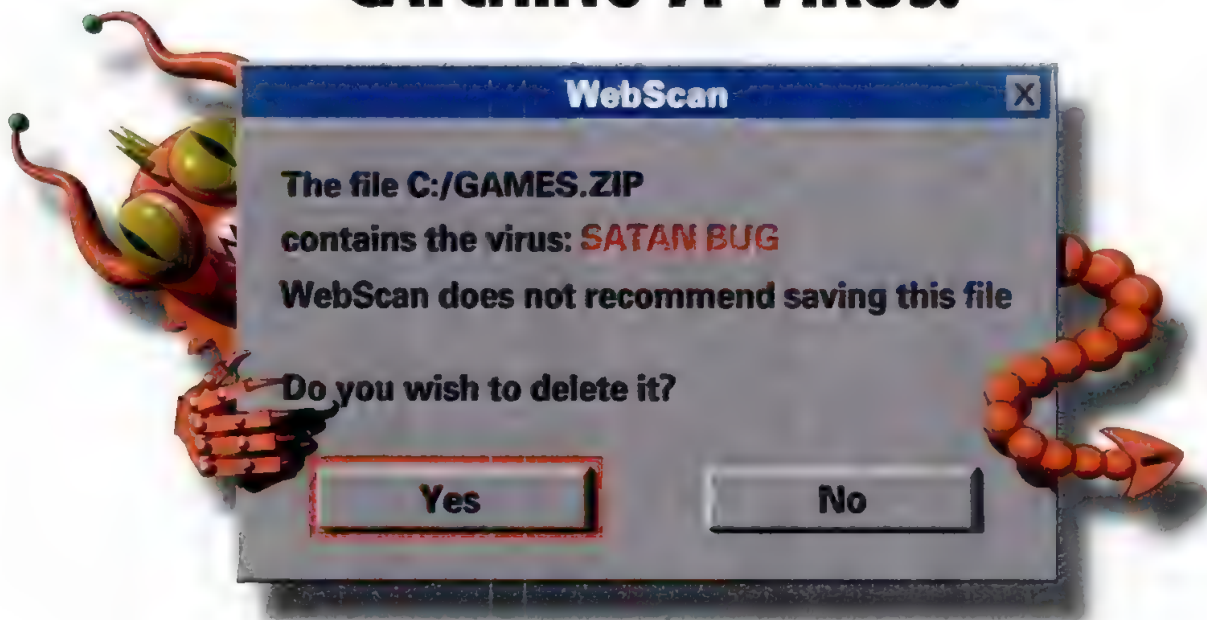
Once you have created your resources

4.0 to test performance. Compared with the same server running NetWare 3.12, we found that Windows NT with FPNW was half as fast, especially when we had all 60 clients connected. Interestingly, we also found that FPNW was actually a little slower than native Windows NT (see the chart above).

THE BOTTOM LINE

FPNW is designed not as a replacement for NetWare, but as a utility to make integration with—and eventually migration to—Windows NT a lot easier. However, FPNW cannot run every NetWare application, and the performance you have to give up may make the switch unacceptable.

HOW TO CATCH WEB FEVER WITHOUT CATCHING A VIRUS.



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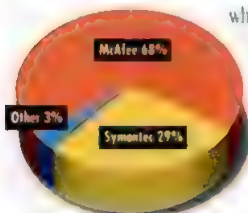
And if you think you're already protected, think again. Regular anti-virus software doesn't protect you from Internet-based viruses.

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WebScan works by creating a temporary quarantine for all downloaded files while it scans for viruses. If the file is found to be infected, the user is alerted and given the option to immediately delete the file.

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CIRCLE 299 ON READER SERVICE CARD

available with a motherboard that offers six PCI slots, through a bridged PCI bus design.)

The Affinity XE's design focuses on expandability and reliability. To that end, the unit includes two fans situated specifically to cool its 12 hot-swappable

SUITABILITY TO TASK

IPC Affinity XE

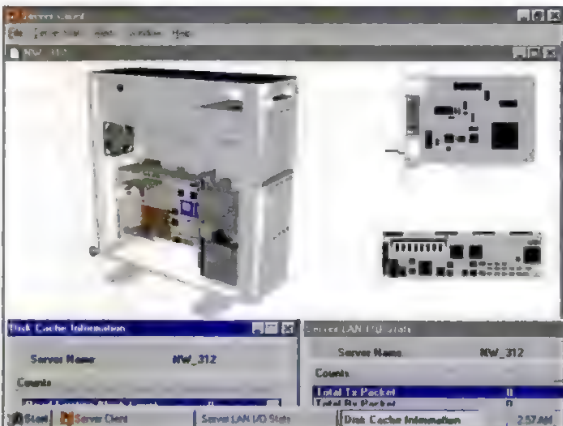
Expandability/ scalability	Good
Performance	Fair
Security/ fault tolerance	Good
Server management	Poor

drive bays. The 500-watt power supply also integrates a thermostatically controlled fan. The Affinity XE supports disk mirroring and RAID levels 0, 1,

and 5 with the Mylex disk controller installed (a \$1,500 option included in the above pricing). It does not, however, support duplexing in the configuration we tested, although you can purchase from the vendor the hardware and software necessary to duplex your disk subsystem.

By the time you read this, a second redundant power supply will be available. Although there is no room for it in the

IPC AFFINITY XE




Affinity Server Management provides alerts and alarms through user-definable thresholds.

case we looked at, IPC is designing a harness to attach to the chassis that will house the additional power supply. Also on the drawing board is an option for an internal board for temperature monitoring and remote notification.

For network management support, IPC currently relies on third-party ven-

dors. A number of packages are available through the company, including Hewlett-Packard's OpenView, IBM's NetView, and Intel's LANDesk. For managing the server, IPC offers its Affinity Server Management package, which polls server information provided by NetWare (Windows NT Server sup-



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Medalist 1640	1.62 GB	Fast ATA-2	16.6 MB/s	10 ms	5,400RPM
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THE DATA TECHNOLOGY COMPANY

RAIDers of the Lost Drive

By Charles Lin

Here's a prediction: Your hard disk will fail. Following Murphy's Law, it's exquisitely timed to go down at the worst possible moment. Your boss will not be interested in why it happened, nor in the 4 hours you'll need for restoration from backup tape. Fortunately, with prices on RAID subsystems dropping, you will be able to minimize downtime and keep this scenario from playing out.

If you are shopping for a mission-critical server with a large storage capacity, you should get to know RAID. RAID (or Redundant Array of Inexpensive Disks) is a technique for combining several small disks into a single volume. You may be using a form of RAID right now such as duplexing or mirroring, but it may not be sufficient for your needs. RAID is categorized into different levels, each providing a different method of combining multiple disks and providing fault tolerance.

STRIPING METHODS

RAID 0, otherwise known as striping, combines multiple disks into a single volume. Striping distributes data evenly across all hard disks, removing physical boundaries. Novell's NetWare does provide software striping, but hardware striping with a RAID controller will provide faster performance. Striping can be done at either the bit or the byte level (RAID 2 and RAID 3, respectively). Most RAID systems, however, use block-level striping to complement the use of data blocks in a LAN environment (RAID 0, 1, 4, and 5). Striping disk arrays also has the advantage of creating a very fast volume, especially for continuous streams of data in multimedia applications.

When researchers at the University of California at Berkeley tested methods for creating a large inexpensive disk from a group of smaller disks, they discovered a potential problem with reliability. Components have an MTBF (mean time between failures) rating.

When you combine multiple disks in a single volume, failure is measured with mean time before data loss (MTBDL), which you can calculate by dividing MTBF by the number of disks in your RAID configuration. You may be surprised and disappointed by the low MTBDL in a RAID system. But the explanation is quite logical: The more parts you have, the more chances there are for something to go wrong.

FAULT TOLERANCE

RAID is designed with fault-tolerance features to recover from disk failures. If you are using NetWare, chances are you use mirroring or duplexing for fault tolerance. Mirroring uses a redundant hard disk to duplicate data that resides on the primary disk. When the primary disk fails, data is recovered from the redundant disk.

Duplexing goes one step further by duplicating the entire disk subsystem, including drives, host adapters, and cables. To increase the capacity of a duplexed disk subsystem, hard disks must be installed in pairs. But although the cost of the hard disks themselves may not create a barrier, restoring data on a duplexed subsystem will still require that you take the server off-line to replace the drive.

RAID 5 provides the best protection for large volumes of critical data. Unlike duplexing, it uses parity information to provide data redundancy. Parity is a method of providing the data protection of mirroring without the cost of mirroring each disk. No matter how many disks you stripe, you only need to keep one disk's worth of parity information to recreate lost data. RAID 5 distributes parity data across all hard disks, so in the event of a disk failure, the disk can be hot-swapped with no downtime.

EXTERNAL RAID SUBSYSTEMS

If you need a large-capacity storage system, you will need more drive units—which will lower your subsystem's overall MTBDL rating. In this

scenario, an external-storage subsystem makes sense, because it would be much easier to replace components that are sure to break. The most likely items to fail are the power supply, the cooling fan, and, of course, the hard disks themselves.

Many external RAID 5 subsystems offer redundant, hot-swappable components to keep everything up and running all the time. Look for a subsystem with front-accessible hard disk modules that connect to the SCSI chain via a common SCSI backplane. These modular subsystems will allow easy hot-swapping without opening the subsystem's case.

A new SCSI specification, SCSI Accessed Fault-Tolerant Enclosures (SAF-TE), is currently under joint development by Intel and Conner (with endorsements from others including DPT, Mylex Corp., and Tricord Systems). The goal of this specification is to provide a standard way to monitor and report on the statuses of cooling systems, power supplies, and hard disks in servers and RAID arrays.

It is certainly a buyer's market in the RAID arena, with many vendors offering excellent external RAID systems. Conner, Cubix Corp., Micropolis Corp., and Storage Dimensions are just a few of the vendors of RAID subsystems. Since most RAID subsystems offer similar levels of performance, look for other features such as hot-swappability, security, scalability, and redundant power supplies.

RAID'S FUTURE

On the horizon are new RAID levels such as Micropolis's Level 5+ to improve the caching capabilities of RAID 5. On the hardware side, be on the lookout for Ultra SCSI RAID adapters from Adaptec and others. Ultra SCSI promises peak transfer rates up to 40 MBps. In the future, we can also expect Serial Storage Architecture (SSA) and Fibre Channel adapters to hit the market, allowing transfer rates of 80 MBps and 100 MBps, respectively.

Departmental File Servers

port will be added in the second quarter of this year). Affinity Server Management features a graphical interface, as well as 88 user-definable statistics for alert and alarm functions. Network administrators can be notified via log, phone, or pager when alerts or alarms are triggered.

On our benchmark tests, the Affinity XE was a second-tier performer. Under NetWare, the system's throughput was in the middle of the pack of the six units tested. At a full client load running NetWare, the Affinity XE's total throughput was about 20 percent lower than the top-performing Compaq ProLiant 1500. Under Windows NT, the unit's throughput peaked at 16 clients, then declined

*To manage the network,
Affinity Server
Management can snap
into HP's OpenView,
IBM's NetView, or
Intel's LANdesk.*

slightly as more clients were added. At a full load of 60 clients, the Affinity XE's throughput was about 75 percent that of the top performers.

Unlike the top-performing Pentium/133 entries that employed synchronous L2 caches, the Pentium/120-based Affinity XE used slower, asynchronous cache. The faster Pentiums also have the advantage of a speedier system bus: 66 MHz, compared with the Pentium/120's 60-MHz bus, as well as a faster PCI bus (33 MHz versus 30 MHz).

The Affinity XE comes with a three-year parts-and-labor warranty. IPC includes one year of on-site service with the server, with a 24-hour response time. An additional two years of on-site service coverage is available.—William P. Flanagan □

Affinity XE. Direct price: \$17,144. IPC Technologies Inc., Austin, TX; 800-752-1577, 512-339-3500; fax, 512-454-1357; <http://www.austindirect.com>. Circle 452 on reader service card.

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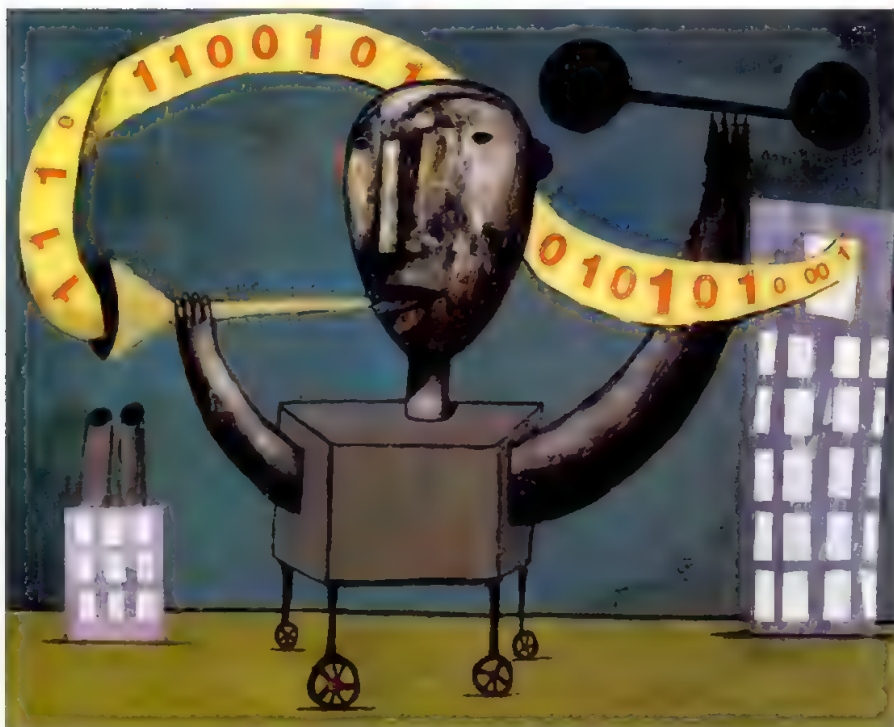
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Promise Fulfilled: DB2 for Windows NT

IBM's new release of its database war-horse lives up to the promise of past versions.

By Brian Butler

It takes great strength of purpose for a company to transform a lackluster product into a star with a single new release. It also takes courage to put a core product on the operating system of an arch rival. With its new IBM Database 2 for Windows NT 2.1, IBM does both, an impressive feat that might not have been possible for the company just a short time ago.

DB2 for Windows NT is heir to one of the most important relational database systems ever built, but its immediate predecessor, IBM DB2/2, lacked the features needed for serious client/server applications (reviewed in "PC-Based SQL: Time to Commit?" October 12, 1993). With the new release, which amounts to a ground-

IN THIS SECTION



TUTOR With all the emphasis these days on big, all-powerful applications from huge, billion-dollar corporations, we thought it was time to step back and show you some small-scale programs that do one thing and do it well. Here are two tiny command line utilities and a program that repartitions your hard disk without deleting data. *page 201*



POWER PROGRAMMING

If you write a second version of an application that uses a different storage format from the first version, you'll want the new program to have the ability to read both formats. With MFC 4.0, you can easily develop such a feature using versionable schemas. We describe Version 1.0 and Version 2.0 of a simple draw program to show how MFC loads and saves documents and how versionable schemas are used to recognize past file formats. *page 205*



INTERNETWORKING

If you haven't been listening to the Web, you're missing out on some of its best offerings. Until recently, downloading audio files took so long that it often wasn't worth the effort, but new technologies not only use available bandwidth more efficiently, they let you start listening while you're downloading. Here's a look at some of these technologies and the products that use them. *page 209*

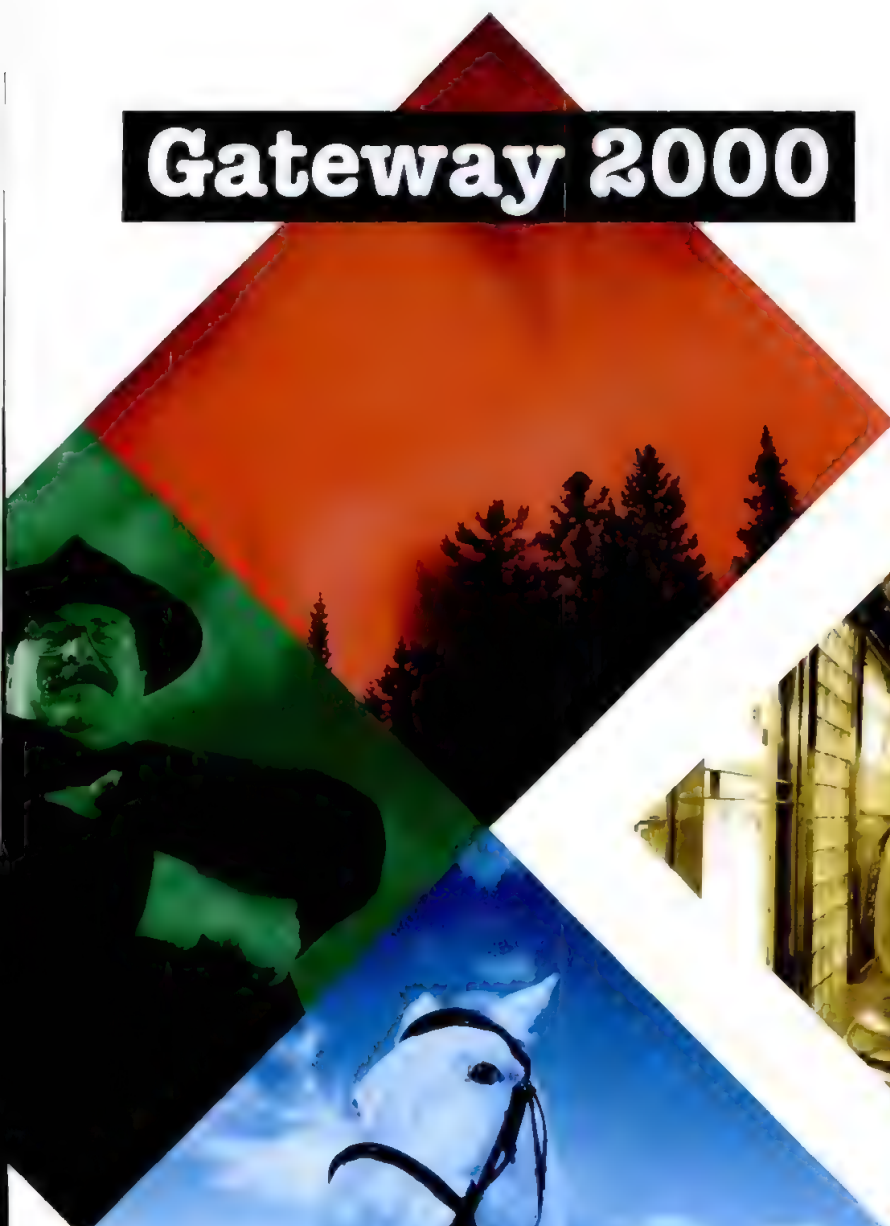


UTILITIES

WSearch is a powerful file- and text-searching program that works under Windows 3.x, Windows 95, and OS/2 Warp. With it you can search filenames *and* text using regular expressions, which include but go beyond DOS's wildcard capabilities. *page 213*

ALSO IN THIS ISSUE PC Solutions describes how to detect Windows 3.x and Windows 95 using a batch file, offers tips on deciphering SIMM sizes, solves some problems frequently encountered while trying to access the Internet from OS/2 Warp, explains how to cancel a print job in Microsoft Word 6 and 7 when background printing is turned on, and more. *page 223*

Gateway 2000



Portable PCs

Aurora borealis. The perfect excuse to get away.

Made sure the battery on my Gateway Solo™ S5-120XL multimedia

notebook was charged, fueled up the truck and headed north. Second quarter projections could wait.

I watched Mother Nature's display dance across the northern sky. And life just seemed to make sense. Looking at my Gateway

Solo S5-120XL multimedia notebook I thought, this machine also makes perfect sense. Think of it. A powerful 120MHz Intel® Pentium® processor, active matrix SVGA color display, 40MB RAM, whopping 1.2GB hard drive, and CD-ROM drive. All the power of a high-end multimedia desktop in a portable package. Who needs more?

A German opera filled the night.

I was deep in thought. Thanks to the modular CD-ROM drive and integrated speakers, features found on all models of the Gateway Solo multimedia notebook line, my favorite German opera filled the night.

Suddenly I heard hoofbeats.



GATEWAY2000
S O L O

Turning I found myself face to chest with a large white horse.

"Hello madam," said the uniformed man atop the horse.

"Is that a Gateway 2000 portable?"

What a coincidence, I have one too!"

Desktop power that fits on a horse.

He reached into his pack and pulled out a Gateway Solo S5-75XL notebook. "My S5-75XL is loaded with a 75MHz Pentium processor, 8MB RAM, and 540MB hard drive. With the 16-bit

sound, stereo

speakers and a

CD-ROM

drive, I can use multimedia applications anywhere.

Even in the boondocks. And

the active matrix SVGA color display provides a great view."

This value-packed system is ideal for the professional person on the go such as myself. And the best part, it fits on a horse," he said with a smile. "Gateway 2000® is the place to go for great values on portable PCs. And while you can compute anywhere, I must ask



EZ Pad™ pointing device for easy cursor navigation.

you to cease and desist." I gave him a questioning look. He continued, "It's mating season for many of our furry friends and we wouldn't want the glow from your



More compute more

active matrix color display ruining their plans. Thank you madam and enjoy your evening." And with a tip of his hat, off he rode.

My commune with nature over, I found an offbeat diner and stopped in for some food. I felt someone watching me. As I scanned the room, our eyes met.

He was sitting at the counter, a Gateway Liberty™ small notebook in front of him. He looked vaguely familiar. I pointed to my portable and mouthed, "Gateway 2000." He smiled and gave me a



computing, places.

thumbs
up. "My
Gateway

Liberty small
notebook is way

cool," he said, pulling up a chair. "Powerful and light weight, man. It's just what I need. I'm a poet now. But I used to have a band."



Gateway Solo notebooks are optimized for Microsoft® Windows® 95.

A band!

Memories of him in a silver jumpsuit and platform shoes came flooding back! He'd been plastered all over



I'm telling you, Gateway is just great!



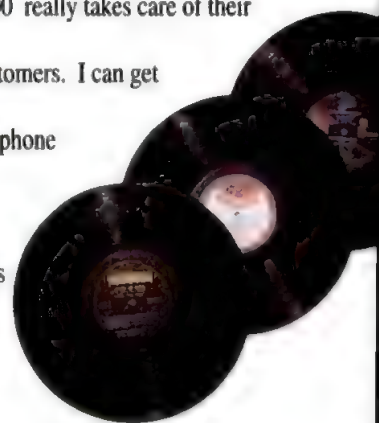
Models from the Gateway Solo multimedia line have a modular CD-ROM drive.

my bedroom walls for years.

"I'm telling you, Gateway 2000 really takes care of their customers. I can get telephone

technical support anytime. And Gateway's values are just out of this world. Hey, you wanna come over to my place and listen to some vinyl?" I had a feeling my adventures were just beginning.

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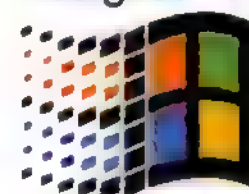
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Microsoft
Windows 95

DB2 for Windows NT

-up rewrite, almost all of our complaints about past releases—and we had a good long list—have been addressed. Today, DB2 for Windows NT offers a state-of-the-art, enterprise-level feature set and strong performance on almost every front. Our only serious remaining complaint, the lack of graphical installation and administration tools, should be addressed by a point release due out by the time you read this.

In addition to targeting Microsoft Windows NT, IBM also offers IBM Database 2 for OS/2 2.1 on OS/2 and is planning releases for a number of Unix platforms, giving DB2 true cross-platform reach. DB2 for OS/2 offers the same database engine, networking features, and de-

veloped by some of the research team members responsible for IBM's pioneering System R, the original prototype of DB2. IBM claims that Starburst is the most advanced optimization technology on the market, more advanced than the mainframe version of DB2, with which it shares some technology. Previous versions of DB2 included support for both cost-based and rule-based optimization, but the cost-based optimizer did not use histograms, storing a wide array of statistics about the data instead. Statistics included number of rows, available indexes, cardinality, and so forth. The problem with this approach was that it did not compensate for skewed data distributions (the optimizer assumed a uniform distribution).

The new Starburst is an embedded expert system that selects the best access path for each SQL query using a detailed set of statistics, including data-distribution histograms in the database. A particularly nice feature is the ability to tune the histograms to compensate

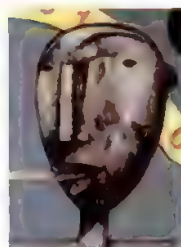
for varying volumes and distributions of data. Starburst has no limit to the number of joins it can optimize (given available free system resources), and it features a query-rewrite capability that helps make queries more efficient. When a query is submitted, it is parsed and its semantics are checked. At this point, a

typical database optimizer would select an execution plan, but DB2 performs an extra step, rewriting the query to more efficient SQL. Query rewriting gives DB2 a distinct advantage over the competition, particularly in View and subquery processing. View processing is particularly tricky for optimizers, since the query's selection must be propagated down to the View's base tables in order to generate an ideal execution plan. DB2's ability to rewrite subqueries was demonstrated in our performance tests, which showed it able to perform as well on a standard correlated subquery as on a hand-optimized correlated subquery.

Another unique and powerful feature of DB2's optimizer is its ability to use I/O speed as

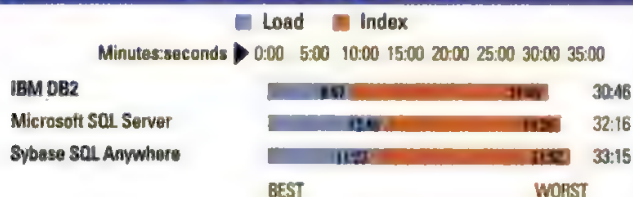
one of the system statistics that determine the cost of a query. Administrators can define the I/O speed for each tablespace, a particularly useful feature in situations where there are large performance differences among physical devices—for example, when a CD-ROM or solid-state disk is used in conjunction with standard hard disks. Knowing the relative speeds of the devices, the optimizer is able to determine the most efficient access method.

More efficient I/O processing is another DB2 enhancement. The new list-prefetching feature helps reduce random I/O by optimizing the physical disk access. When indexes are available, DB2 can use them to build a list of record identifiers (RIDs), which are then sorted in ideal order for physical disk access. When table scans or large sorts are required, DB2 uses sequential prefetching to retrieve the data for the physical disk in large blocks. DB2 also now supports parallel input and output to achieve maximum throughput.



IBM claims that Starburst is the best optimization technology on the market.

LOAD AND INDEX TEST



This graph shows the time each product required to load and index a 40MB database consisting of four 100,000-row tables. Each row is approximately 120 bytes. While we saw comparable results across all three products, DB2 is narrowly the front-runner in load operations and overall time.

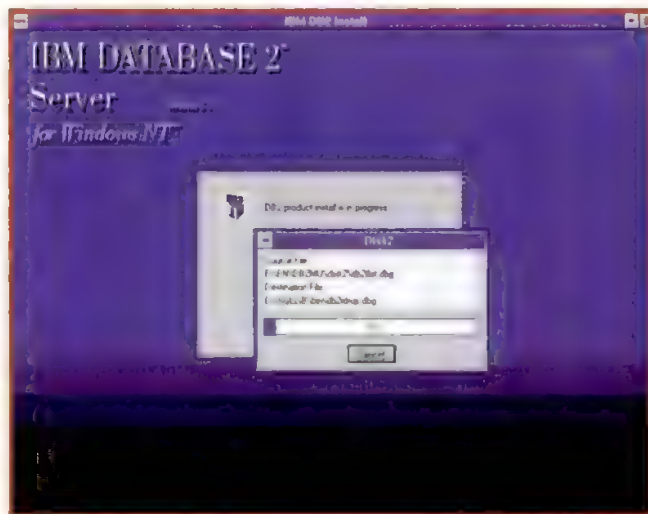
veloper interfaces as the Windows NT product we review here. It also includes graphical tools not yet available in the Windows NT version, but not the NT-specific performance monitoring and security features.

Despite a strong family resemblance to releases on other platforms, DB2 for Windows NT is more than a straight port of the common DB2 database engine. IBM has gone out of its way to implement DB2 as a native Windows NT application that can be started as a Windows NT service or as a standalone server. Like its cousin IBM DB2/2, DB2 for Windows NT uses native operating system threads for improved SMP scalability. It also includes support for Windows NT's Event Log and Performance Monitor (which lets you track more than 130 different DB2 statistics) and is closely integrated with the Windows NT security system. DB2 for Windows NT does not support the Windows NT Server licensing control, however.

SUPERCHARGED ENGINE

The new release adds many important new engine features, including a significantly improved optimizer, triggers, stronger declarative referential integrity, user-defined functions, binary large object (BLOB) support, improved disk management, and online backup. These welcome changes propel DB2 into the first ranks of industrial-strength client/server database management systems.

The new optimizer technology was high on IBM's priority list of enhancements. DB2's new



SETUP started out easily, but we had to use many undocumented tricks to get everything running. Setup and administration are the only remaining weak links in an otherwise strong product.

This new release also addresses DB2/2's previous one-volume limit on database size by letting you divide a database into separately managed tablespaces. It also adds support for

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System requirements: A PC equipped with a 680, 486, Pentium or equivalent processor. Windows 3.11 or Windows 95. Windows 95 requires 10 MB of free hard disk space. Windows 95 requires 10 MB of free hard disk space. Windows 95 requires 10 MB of free hard disk space.

DB2 for Windows NT

raw disk devices, letting it support more disk drives than there are letters of the alphabet. DB2's tablespace support is very similar to Oracle7's Tablespaces and somewhat like Sybase SQL Server's Devices. Tablespaces let the administrator specify where tables or indexes are created by specifying the tablespace in which they reside. Tablespaces also improve the granularity of database administration. For example, you can perform online backup at the tablespace level.

DB2 has long offered declarative referential integrity, including primary and foreign key constraints; Cascade, Restrict, and Set Null options for delete operations; and Restrict and No Action for updates. Version 2.1 enhances

on OS/2 and it lacked a call-level interface and ODBC support. A subsequent point revision, Version 1.2, added 16-bit ODBC support and DOS client development tools but failed to address other shortcomings. Thankfully, this latest release has greatly expanded developers' options by providing support for a call-level interface (CLI), Microsoft Visual C/C++, and 32-bit ODBC, as well as client/development support for Windows 3.x, Windows 95, and Windows NT. This now gives DB2 three familiar programming interfaces: an embedded SQL precompiler, a CLI, and ODBC access.

IBM's unique approach to embedded SQL applications offers many of the same security and performance benefits found in stored pro-

cedures, with the additional benefit of not having to maintain server-side code. When you precompile (IBM's term is "bind") application source code containing static SQL, DB2 compiles your embedded static SQL and creates a package. A package is similar to stored procedures in that it contains preoptimized SQL stored on the database server. The ap-

proach has both performance and security benefits. Since your application's SQL statements do not need to be parsed and optimized at runtime, it executes faster. In addition, you can then grant user privileges on the package level without granting the same privileges on the underlying tables.

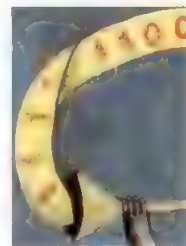
While prebinding has benefits, it is not without its drawbacks. The process is rather cumbersome, and the fact that you explicitly need to rebind all applications that use affected tables after a structural change to the underlying tables is an administrative inconvenience.

If you're familiar with the ODBC API, you will find IBM's CLI very familiar as it is essentially a disjointed superset of ODBC. IBM started with the ODBC Version 2.0 specification and implemented all but three of its functions. Then it added several X-Open APIs and some DB2-specific enhancements, including better BLOB support and control over transaction isolation. The advantage of using CLI over ODBC is that resource requirements

are lower, since CLI does not require the Microsoft ODBC manager and ODBC's multitiered driver architecture. IBM claims the performance of ODBC and CLI is about the same, since the ODBC wrapper is quite thin. The drawback to using CLI and ODBC is that they do not support the binding process.

UDTs AND UDFs

Version 2.0 offers two new ways to extend your database to meet particular needs: user-defined types (UDTs) and user-defined functions (UDFs). UDTs let you define new data types based on existing DB2 data types. On the surface this may seem trivial, but it's the basis for object-oriented databases and enhances data integrity by allowing stronger type enforcement. For example, you could create three types—American dollars, British pounds, and French francs—using the base type of float. While all the data types represent money, the implied semantic is that American dollars cannot simply be added to British pounds without an exchange-rate conversion. An attempt to do this



UDTs may sound trivial, but they are a basis for object-oriented databases.



This graph shows the time required for each database to export a single table of 100,000 rows to a comma-delimited file. DB2 and Microsoft SQL Server are generally comparable, with SQL Anywhere far faster than both. Table exports are typically used to move data to another location—for example, a data warehouse, a database from another vendor, or even a spreadsheet.

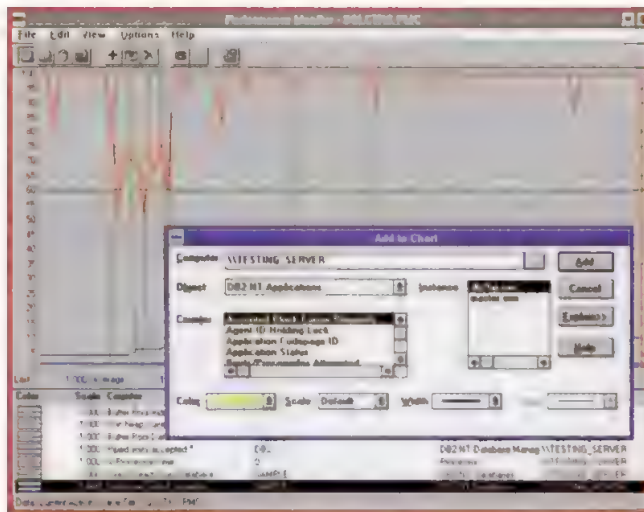
declarative referential integrity by adding support for Check constraints, so you can check values against a range of values or against other columns within the same row. Version 2.1 also supports triggers, which are useful for enforcing business rules or as an alternative method for maintaining audit trails. Administrators can specify whether a trigger should fire before or after the triggering event (Insert, Update, or Delete) and how often it fires (once per row or only once per SQL statement). DB2 also supports multiple triggers per triggering event.

As with many other products, a trigger consists of one or more SQL Insert, Update, or Delete statements. But in contrast to other products (Oracle7 or SQL Server, for example), you cannot write procedural code within a trigger or call a stored procedure. This makes it very difficult to implement complex triggers without resorting to a user-defined function (UDF). Since UDFs cannot include SQL statements, however, they represent an awkward workaround.

The new release expands DB2's data-handling capabilities through BLOB support. Other features include support for server-side (forward-only) cursors and all four isolation levels: uncommitted read, cursor stability, read stability, and repeatable read.

IMPROVED PROGRAMMER OPTIONS

When we last tested IBM DB2/2 (in Version 1.0), the DB2/2 precompiler was available only



DB2'S INTEGRATION with the NT Performance Monitor was tough to set up, but it offers a wealth of more than 130 different statistics.

would result in a DB2 type-conversion error.

This example also suggests how UDFs might come into play. UDFs can be called from within a SQL statement to perform any function that returns a single scalar value. Thus, it's pos-



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sible to write functions to convert money from each currency type using the appropriate exchange rates. UDFs are also useful for performing calculations or extracting parts of a value (extracting part of a BLOB, for example). UDFs do impose a significant restriction in that they cannot contain any SQL statements, however (in this example, you'd have to recompile when exchange rates change).

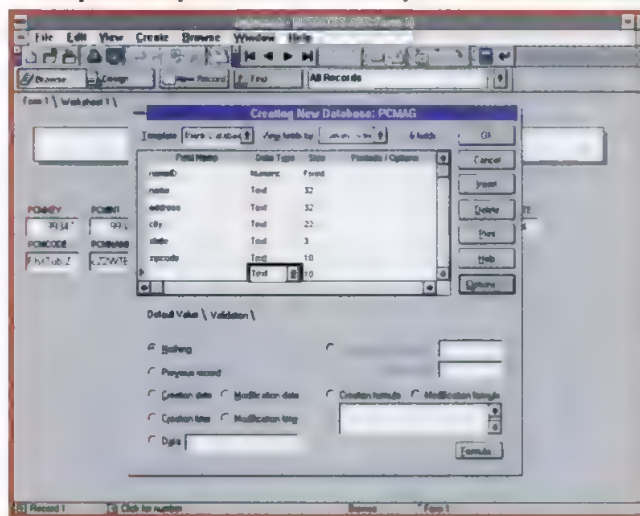
IBM's approach to server-side programming is unusual in that it provides no specialized language for coding stored procedures, triggers, and UDFs. Instead, IBM has opted to use languages such as C or Cobol to write stored procedures and to wrap the functions inside a dynamic link library (DLL), which is then linked to the server code. While using this method is more flexible than using a vendor-specific language such as Oracle's PL/SQL or Sybase's Transact SQL, it is equally complex and potentially hazardous. Since user code is linked to the database server, stray memory pointers and other program bugs can take down the database server. Because of this danger, DB2 offers the option of running stored procedures in a separate, protected address space (a similar option to Microsoft SQL Server's extended stored procedures). But for those risk-happy souls who want performance above all else, another option allows you to pare overhead to a minimum by letting stored procedures share the database kernel address space.

WANTED: GUI TOOLS

As impressed as we were with DB2's core technology, we still felt that there's much to be desired in the ease-of-use department. Unlike most of its competitors, DB2 has no GUI tools for Windows NT, forcing us to resort to command line utilities to accomplish all our database administration tasks. A point revision, Version 2.11 (which should be shipping by the time you read this), is slated to include ports of all the GUI tools now found in the OS/2 ver-

An exception is Visual Explain, an intriguing OS/2 tool that would make a welcome addition to DB2 for Windows NT. Only Microsoft provides a similar graphical mechanism, which lets the administrator view a graphical representation of the access plan that the optimizer chooses for a SQL statement. We found Visual Explain to be more complete in its features than Microsoft's tool, as it allowed us not only to view the access method but to see a wealth of statistics gathered at each step.

One particularly nice feature is its ability to



LOTUS APPROACH, bundled with DB2, lets you perform basic administration tasks but doesn't obviate the need for a full set of GUI tools.

capture the SQL statements for an entire database session, then let you view the statistics at your leisure. In contrast, Microsoft's SQL Enterprise Manager tool requires you to examine each query separately. One shortcoming of Visual Explain is its inability to view access plans for heterogeneous servers. We were not able to use the OS/2 version of Visual Explain to examine a Windows NT database, because the information is transferred from server to client as an operating system-specific binary.

The version of DB2 we tested included Lotus Approach 96 for Windows 95, an easy-to-use PC database that came to IBM as part of its recent acquisition of Lotus. Approach offers basic integration with DB2: Connecting via ODBC, it can act as a front end for some limited administrative functions such as creating tables, importing data, and creating forms and reports. Approach is a nice package, but it doesn't make up for DB2's lack of dedicated graphical administration tools.

IBM told us that Approach will be dropped from the DB2 bundle as soon as native graphical tools are available.

INSTALLATION HEADACHES

DB2 uses the standard Windows SDK install facilities. Overall, we found the installation adequate but not complete. We had to learn a number of tricks along the way, none of which were included in the online documentation or Readme files. It took a day of tweaking before we connected successfully from our test work-

station using both DB2 utilities and ODBC. In retrospect, the process should have taken no more than half an hour.

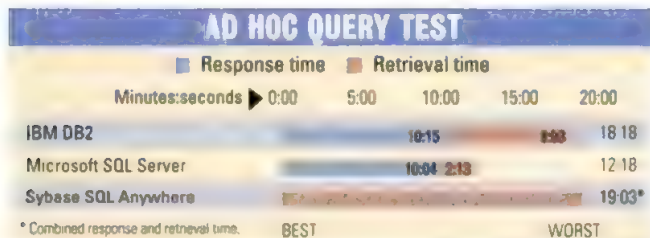
On our first attempt, we used the Windows NT default Administrator account. When we tried to install the software, we were greeted with an error message telling us we needed administrator privileges (which we already had). Thinking that the default login ID had somehow been corrupted, we created an account called DB2ADM that had administrative privileges. This tactic

worked. The problem turned out to stem from a porting issue: While DB2 supports integrated security with the Windows NT security system, it can only support user names of up to 8 characters in length (Windows NT supports user names of up to 20 characters). Thus, for accounts requiring access to your DB2 database, you must limit your user name size.

Getting a client workstation to connect to DB2 required negotiating a few more hurdles. While DB2 supports APPC, NetBIOS, SPX/IPX, and TCP/IP, none of them are automatically configured. For our tests, we used TCP/IP. After fumbling through the documentation and release notes for a couple of hours (and finally getting a little help from IBM), we were able to get a client/server connection working.

The process involved first configuring the server. The initial step was to set the environment variable DB2COMM=TCPIP. The next step, no less obscure, required us to define a TCP/IP port by manually editing the TCP/IP SERVICES file. The final step was updating the database manager's configuration parameter SVCENAME using the command UPDATE DATABASE MANAGER SVCENAME DB2. This tells DB2 which TCP/IP port to use (it should correspond to the port name you define in your services file). None of this is the stuff that ease of use is made of.

Setting up the client required the same



This graph shows the time each database takes to execute 33 queries, which return 222,444 rows. All the queries were executed using ODBC. Response time is the time for the first row to return to the client. Retrieval time is the total time needed to send all rows to the client. (Our test was not able to distinguish accurately between SQL Anywhere's response and retrieval times.) The results show that DB2's query optimizer was on a par with Microsoft SQL Server's but that its out-of-box network efficiency was lower.

sion. While this will be an improvement, the current OS/2 tools also lag behind the standards set by Microsoft, Oracle, and Sybase.

steps as the server, with a couple of additional steps to define the remote database connection. We needed to use the interactive command line SQL utility but found the commands to be well documented and straightforward. In the OS/2 version of DB2, IBM provides a much friendlier GUI utility that aids in the definition of a remote database (a Windows NT version should be included with the next maintenance release).

After confirming that we had connectivity using IBM's command line utilities, we moved on to testing ODBC connectivity. The ODBC installation program is located in the DB2 program manager group (and it isn't easy to find, since all of DB2's program icons look the same). Once set up, the ODBC connection worked well and we were able to run our test scripts without a hitch.

During testing, we tried to monitor database statistics but found that DB2 had no entries in the NT Performance Monitor. Finding no documentation, we called IBM. The company walked us through the steps needed to install the performance monitor. The first is to run DBPERFI/1, which installs and registers DB2's Performance Monitor DLLs. If you want to monitor your database server remotely, you must also register a default user name and password for Performance Monitor to connect to DB2. Typically Performance Monitor runs under a user name of SYSTEM, but this is a reserved word in DB2 syntax and cannot be used. IBM provides the DBPERFR.EXE utility to let you register a user name to connect to DB2. After configuration was complete, we found that DB2 let us monitor a wealth of different statistics—more than 130.

All in all, DB2's installation facilities are far less complete than those of other products such as Microsoft SQL Server, Oracle7, or Sybase SQL Server. The installation process should prompt you for which network you wish to support, and the server (or client) should then be configured accordingly. The database performance monitor should install by default or the user should be prompted for the proper action. We hope future releases will offer these features.

LOAD AND INDEX PERFORMANCE

Our Load and Index test involved loading four tables that each contained 100,000 rows. We first loaded the tables using Lotus Approach 96. While we found Approach's interface to be attractive and intuitive, its performance as a load tool was poor. Loading a single 100,000-row table took more than 2 hours. For our next trial, we used the IMPORT function offered by DB2's command line utility. Loading the tables from a remote client proved to be substantially

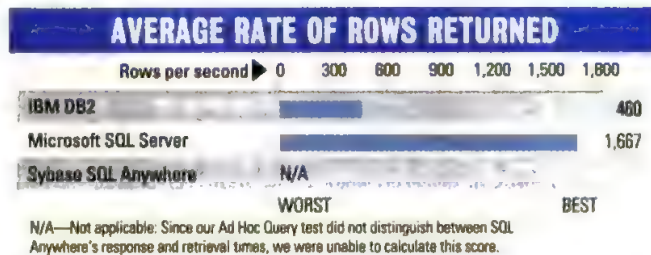
faster, about 15 minutes per table. The fastest method we found was to use the LOAD command. This approach required us to copy the data to the test server and load it directly into the database. DB2's excellent load time



Our tests were not intended to show the optimum performance of each database but how it functions in the hands of an average user.

of 8 minutes 57 seconds for all four tables compared favorably with Microsoft SQL Server 6.0's result of 12 minutes 46 seconds.

DB2 was able to create all the indexes used in the test in a reasonable 21 minutes 49 seconds compared with Microsoft SQL Server's result of 19 minutes 30 seconds.



The average rate of rows returned is a measure of the databases's efficiency at sending rows to the client over the network. We calculated the results by dividing each product's total retrieval time (from our Ad Hoc Query tests) by the number of rows returned. This average is a good performance indicator for reports that return large numbers of rows to the client. DB2 was clearly less efficient than Microsoft SQL Server.

EXPORT TABLE PERFORMANCE

Our Export Table test measures how fast the database can export a 100,000-row table into a comma-delimited ASCII text file. The export is made to a local disk on the server to avoid network overhead. DB2's export time was slightly faster than that of Microsoft SQL Server; both were beaten by Sybase SQL Anywhere's blistering time of 1 minute 12 seconds.

AD HOC QUERY PERFORMANCE

DB2 performed our Ad Hoc Query test without any problems, and the results demonstrated its ability to achieve acceptable performance without recourse to hand-tuning queries or the data-

base server. Overall, DB2's response time was comparable to Microsoft SQL Server's, although DB2 could not keep up with SQL Server's speed when sending rows across the network. Although we believe we could have improved the DB2 timings by tuning the network layer, the purpose of our tests was simply to demonstrate the performance a nonexpert user could achieve after standard installation.

Our tests also showed the value of DB2's new query-rewrite capability. It was able to execute a standard correlated subquery in 35 seconds and a hand-tuned version of that query in 16 seconds. (SQL Server achieved a time of 95 seconds for the standard query and a subsecond response for the hand-tuned query; Sybase SQL Anywhere took 78 seconds for the first query, with a subsecond response on the second one.)

Our tests of DB2 were based on a subset of the AS3AP (ANSI SQL Standard Scalable and Portable) benchmark tests. Our server was a Dell 486/66 with 32MB of RAM and a 1GB hard disks running Microsoft Windows NT Server 3.51. The test client was an HP Vectra XU 590C running Windows NT Workstation 3.51.

Our test database consisted of four 100,000-row tables of the same structure. The queries were executed using 32-bit ODBC drivers, and we used TCP/IP as our network protocol. All the queries were executed using Visual SQLBench 1.1 utility from Client/Server Solutions Inc.

Again, our tests were not intended to show the optimum performance of each database server but were designed to see how well these products function in the hands of an average user. The only parameter we adjusted was database cache size, choosing a 16MB cache for all products.

IN THE FINAL ANALYSIS

Overall, we were quite impressed with the features and performance of DB2. We expect that future releases will remedy its only serious failings, the lack of intuitive GUI administration and its counterintuitive setup. The coming point release, due before this

article appears, should already address some of these issues. □

IBM Database 2 for Windows NT 2.1. List price: \$369, single-user license; \$1,499, 5-user license; \$75 for each additional license. IBM Corp., Armonk, NY. 1-800-IBM-3333; <http://www.software.ibm.com>. Circle 458 on reader service card.

Brian Butler, a contributing editor of PC Magazine, is president of Client/Server Solutions, a St. Louis-based firm specializing in SQL database performance testing and application development. He is the chief architect of PC Magazine's SQL database performance tests.



PC Tech/Tutor

By Jeff Prosis

One for the Little Guys

Three diminutive utilities that can save you a lot of work and frustration.

For more than ten years, *PC Magazine* has been publishing utilities to fill in the holes left by operating system manufacturers. In the early days of our Utilities column, programs were written in assembly language and rarely exceeded 700 bytes in length. (Amazing what you could do in 700 bytes back then.) In recent years, however, utilities have grown in size and complexity. A typical *PC Magazine* utility today is built from more than 5,000 lines of code and written in C, C++, Delphi, or Visual Basic. There's not much room for the little guys anymore, especially when there are so many powerful utilities in the works.

This column is about three of the little guys. Actually, one of them isn't so little—it's a commercial product that's fighting for shelf space at the retail stores. But it's so remarkable that you'll want to know about it, especially if the recent Tutor columns taking VFAT to task for not fixing many of the FAT file system's inadequacies made an impression on you (for more information, refer to our issues of June 27 and October 10, 1995). The other two are tiny utilities I wrote myself: a DOS utility written at the suggestion of a reader and a Windows 95 utility that fulfilled a personal need. Neither will change your life, but both are free and both are extremely handy, given the right set of circumstances.

A TEE UTILITY FOR DOS

Most DOS users are familiar with the concept of input and output redirection. The command

```
dir >files.txt
```

creates a directory listing and uses output redirection to capture the listing in a text file named Files.txt. Similarly, the command

```
debug <script.txt
```

runs DOS's DEBUG utility in batch mode and executes the commands stored in Script.txt as if they had been typed at the keyboard. The piping operator (|) combines input and output redirection into one operation by taking the output from one command and using

it as the input for another. The command

```
type autoexec.bat | more
```

lists the contents of an AUTOEXEC.BAT file on the screen and pipes the output to DOS's MORE filter, which pauses the listing each time the screen fills.

There are plenty of creative uses for redirection and piping that make them weapons

in the hands of power users. One of my favorites is shown below. Added to an AUTOEXEC.BAT file, the following statements create a log of the dates and times that a PC is turned on:

```
echo. | date | find "Current" >>
  c:\Usage.log
echo. | time | find "Current" >>
  c:\Usage.log
echo. >>c:\Usage.log
```

With these statements in place, an entry like this one is written to c:\Usage.log each time you power up:

```
Current date is Sat 09-30-1995
Current time is 7:15:00.00a
```

Usage.log is a standard text file that you can view with the TYPE command or browse with the EDIT command.

One of the redirection and piping tools DOS lacks is a Unix-like TEE command that simultaneously redirects output to a file or printer and displays it on the screen, too. You can list the contents of a directory to the screen and you can capture the listing in a file, but you can't do both at once without a TEE command. The DEBUG script in Figure 1 creates a TEE utility for DOS. To execute the script, use EDIT or the text editor of your choice to enter the listing in a text file named Tee.txt. Then type

```
debug <tee.txt
```

at the command prompt to create Tee.com.

With TEE, the following command displays the contents of the current directory on the screen and captures the listing in Files.txt:

```
dir | tee files.txt
```

TEE's output can also be directed to a printer by specifying the printer's device name on the command line:

```
dir | tee prn
```

PRN is DOS's name for the printer attached to LPT1. You can direct output to other printers by substituting LPT2 or LPT3 for PRN.

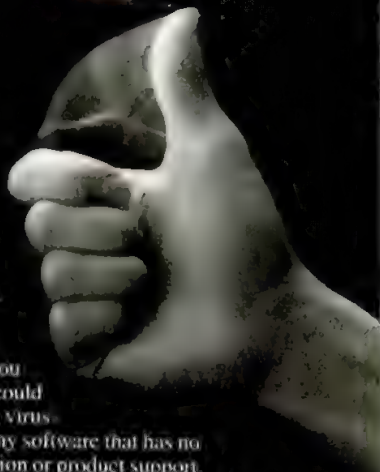
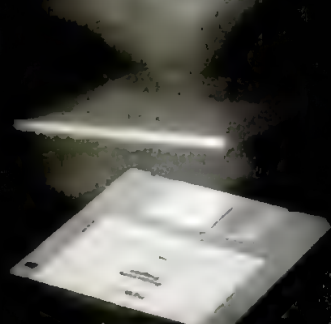
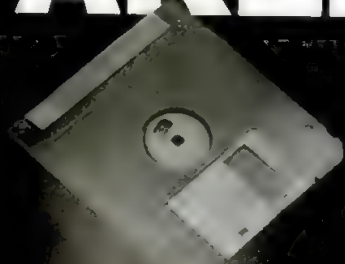
Tee.com is also available in the Tutor library of ZD Net's Tips/Utilities forum on CompuServe. The assembly language source code (Tee.asm) is available too, just in case you'd like to see how it works.

```
N TEE.COM
E 0100 FC BE 01 00 AC 3C 20 74
E 0108 FB 3C 09 74 F7 3C 0D 74
E 0110 1D 8B D6 4A 8B FE B0 0D
E 0118 B9 FF FF F2 AE C6 45 FF
E 0120 00 B4 3C 33 C9 CD 21 72
E 0128 0A A3 F1 01 EB 0D BA 98
E 0130 01 EB 03 BA 87 01 B4 09
E 0138 CD 21 C3 33 FF B4 3F B8
E 0140 00 00 B9 01 00 BA F3 01
E 0148 03 D7 CD 21 0B C0 74 16
E 0150 B4 40 B8 01 00 B9 01 00
E 0158 BA F3 01 03 D7 CD 21 47
E 0160 81 FF 00 02 75 D7 B4 40
E 0168 8B 1E F1 01 0B CF E3 11
E 0170 BA F3 01 CD 21 72 13 3B
E 0178 C7 75 14 81 FF 00 02 74
E 0180 BA B4 3E 8B 1E F1 01 CD
E 0188 21 C3 BA D4 01 EB 03 BA
E 0190 E7 01 B4 09 CD 21 EB E9
E 0198 53 79 6E 74 61 78 3A 20
E 01A0 63 6F 6D 6D 61 6E 64 20
E 01A8 7C 20 54 45 45 20 66 69
E 01B0 6C 65 6E 61 6D 65 24 55
E 01B8 6E 61 62 6C 65 20 74 6F
E 01C0 20 63 72 65 61 74 65 20
E 01C8 6F 75 74 70 75 74 20 66
E 01D0 69 6C 65 24 49 2F 4F 20
E 01D8 65 72 72 6F 72 20 6F 6E
E 01E0 20 77 72 69 74 65 24 44
E 01E8 69 73 6B 20 66 75 6C 6C
E 01F0 24 00 00
RCX
F3
W
Q
```



FIGURE 1: DEBUG script for Tee.com

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DETABBING IN WINDOWS 95

Speaking of redirection and piping: For years I've been using a homemade DOS utility named DETAB to convert tabs in text files into spaces before shipping the files off for publication or private dissemination. Converting tabs into spaces is crucial if columns of information in program listings and other text printed in fixed-pitch fonts are to line up properly, because different text editors and typesetting programs expand tabs differently.

The problem with DETAB is that it has to be applied to every file individually. It stores the detabbed version of the file under a new name, so each DETAB command has to be followed with a MOVE command that replaces the tabbed file with the detabbed file. Detabbing one file requires a sequence of commands like this one:

```
detab 4 <myfile.txt> myfile.det
move myfile.det myfile.txt
```

That's why I wrote Detab for Windows (henceforth DetabWin), which is shown in Figure 2. The interface is simple: You dial in the number of spaces between tab stops by clicking the up and down arrows, click the Select File(s) button to display the file-selection dialog, select the file or files you want to detab, and click. The files are detabbed, just like that. You can detab one file or hundreds of files in a single operation. Detabbing is performed in place, which means that if you detab a file named Myfile.txt, the detabbed version is named Myfile.txt, too. If you want to keep the original version, make a copy of it before detabbing it with DetabWin.

DetabWin is too big to supply as a DEBUG script, so if you would like a copy, you'll need to download it from PC Magazine Online (<http://www.pcmag.com>; CompuServe: GO ZNT:TIPS). The source code is available, too. DetabWin was written in C++ with MFC (the Microsoft Foundation Classes library) and compiled with Microsoft's Visual C++.

PARTITION MAGIC FROM POWERQUEST

PC users are familiar with what a chore it can be to repartition a hard disk. Partitioning divides a hard disk into one or more logical volumes (C:, D:, E:, and so on) and is usually performed with DOS's primitive FDISK utility. The problem with FDISK is that it destroys any data already on the hard disk. Once a drive is partitioned, its configuration is cast in stone unless you're willing to back up everything on it, run FDISK again, reformat the partitions, and restore what you backed up.

The problem with partitioning in general is that large hard disk partitions on a PC run-

ning DOS or Windows are incredibly inefficient at storing files. Today 1.2GB drives are commonplace, but if a 1.2GB drive is partitioned as one big logical volume, easily 400MB of disk space can be lost to cluster overhang—the difference between the smallest unit of space the FAT and VFAT file systems can allocate to a file and the file's actual length. A file only 1 byte in length, for example, consumes 32,768 bytes of space on a 1.2GB volume.

One way to beat the rap is to switch to OS/2 or Windows NT so you can use the HPFS or NTFS file systems, respectively. Another option is disk compression, which drastically reduces and in some cases altogether eliminates cluster overhang. But the solution that many users find the most palatable is partitioning the drive into smaller volumes. Partitioning a 1.2GB drive into three 400MB volumes reduces the total space lost to storage inefficiency to about 100MB. That's 300MB of extra disk space just because you partitioned the drive properly. If it were easier, you can bet that more people would be repartitioning those big drives that came with their new systems.

A new \$49.95 product from Utah-based PowerQuest makes repartitioning a snap. Partition Magic is the replacement for

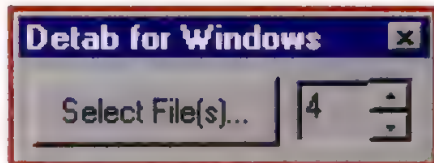


FIGURE 2: This Windows 95 program lets you replace tabs with a specified number of spaces.

FDISK that should have been built into DOS ten years ago. It repartitions a hard disk on the fly and does so without destroying your valuable files. There are versions for DOS, OS/2, Windows 3.x, and Windows 95. The OS/2 version can move files from FAT to HPFS partitions, and the Windows 95 version will double the size of the root directory to counter some of the adverse effects of long filenames.

Contrary to rumors that have circulated on CompuServe and elsewhere, Partition Magic does *not* magically shrink the cluster size without shrinking the partition size, too. But most users would agree that dividing a 1.2GB C: drive into 400MB C:, D:, and E: drives is a small price to pay to recover about 25 percent of the drive's storage space.

If you would like more information about Partition Magic, contact PowerQuest at 801-226-8977. If you ever need to repartition a drive, this little gem will pay for itself the first time it's used. □

Jeff Prosis is a contributing editor of PC Magazine.



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PC Tech/Power Programming

By Jeff Prosise

Using Versionable Schemas in MFC 4.0

Give your Version 2.0 apps the ability to read Version 1.0 file formats.

Windows applications that use MFC's document/view architecture have a unique but simple method for loading and saving their documents. Instead of using standard file I/O functions to write a document to disk or read it back, most MFC applications rely on a process known as *serialization*. When the user selects the Open or Save command from the application's File menu, the framework opens the file for reading or writing, attaches a CArchive object to abstract the physical storage medium, and calls the document's Serialize function with a reference to the CArchive. You must write the Serialize function that streams the document's data in or out, but the framework provides the context in which Serialize executes.

Very often, you can serialize an entire document with just a few lines of code, because the document's data is stored in objects that are themselves serializable. When you write a serializable class in MFC (Microsoft Foundation Classes), you assign the class an integer ID, called a *schema number*; that MFC uses as a crude form of version control. MFC tags objects of the class with the schema number when it writes them to disk. Then, when it reads them back, it compares the schema number recorded in the file with the schema number of the objects in memory.

If the two don't match, the application framework throws a CArchiveException with a cause code equal to CArchiveException::badSchema. An unhandled exception of this type displays a message box with the warning "Unexpected file format." By incrementing the schema number each time you revise an object's storage format, you provide an effective safeguard against inadvertent attempts to read an old version of an object stored on disk into a new version that resides in memory.

One of the more difficult problems you'll encounter when writing serializable classes is handling objects created with past versions of your application. If an object's persistent storage format changes from one version of your application to the next, you'll probably want the new version of your application to be able

to read both formats. But as soon as MFC sees the mismatched schema numbers, it will throw an exception. Because of the way MFC is designed, there's no good way to handle the exception other than to do as MFC does and abort the serialization process.

That's where versionable schemas come

MFC's versionable schema mechanism can provide the backward compatibility that users expect.

For two very good reasons, however, versionable schemas have a reputation for being unreliable and difficult to implement. First, 16-bit versions of MFC didn't support versionable schemas. Second, a bug in early 32-bit versions of MFC prevented versionable schemas from working consistently. It wasn't until MFC 4.0 was introduced late last year that you could use versionable schemas and be sure your code would work. Now it's easy to write a Version 2.0 of your application that will read documents created by Version 1.0, even if the document formats differ. I will show you how to do this by presenting two sample programs that use similar but not identical persistent storage formats. Key portions of the applications' source code are reproduced in the article, but you can download the full source code and .EXE files for both programs from PC Magazine Online.

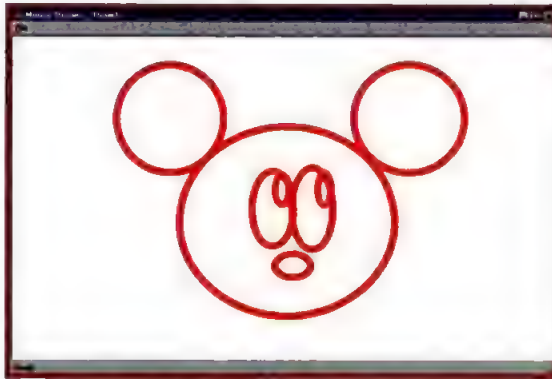


FIGURE 1: A simple sketch that combines various circles drawn with the Draw1 application.

in. A *versionable schema* is simply a schema number that includes a VERSIONABLE_SCHEMA flag. This flag tells MFC that the application can handle multiple document formats. It suppresses the CArchiveException, thus allowing an application to respond intelligently to different schema numbers. An application that takes advantage of

THE DRAW1 APPLICATION

Draw1 is a simple document/view application that lets you draw circles (actually ellipses, of which circles are a special case) on the screen with your mouse. To draw a circle when running the application, press the left mouse button, drag the mouse with the button held down, and release the button when the circle is the size you want. A bright red circle will replace the thin black circle that you see as you move the mouse. You can combine circles to create simple drawings like the one in Figure 1.

The circles that you create using the Draw1 application are represented by objects of type CCircle, and the document object stores pointers to CCircles in a linked list created from MFC's handy COBList class. CCircle is a serializable class that is publicly derived from CObject in the source code files Circle.h and Circle.cpp. The CCircle class declaration used in the Draw1 application is reproduced in Figure 2. The DECLARE_SERIAL macro declares the class to be serializable, and the following statement in Circle

```
class CCircle : public CObject
{
    DECLARE_SERIAL (CCircle)

private:
    CRect m_rect;

public:
    CCircle () {}
    CCircle (LPRECT);
    virtual void Serialize
        (CArchive&);
    virtual void Draw (CDC*);
};
```



FIGURE 2: The CCircle class declaration from the Draw1 application.

.cpp assigns a schema number of 1 to this implementation of CCircle:

```
IMPLEMENT_SERIAL (CCircle, CObject, 1)
```

The data that defines a circle is stored in the private CCircle data member `m_rect`, which is a `CRect` object that stores the coordinates of the circle's bounding box. To draw a circle on the screen, `Draw1`'s view class `CDrawView` obtains a `CCircle` pointer from the document object and calls `CCircle::Draw` through that pointer. `CCircle::Draw`, in turn, uses `CDC::Ellipse` and the coordinates stored in `m_rect` to draw the circle.

Because the information stored in `m_rect` is all that's needed to define a circle, `CCircle::Serialize` contains just a few simple statements:

```
void CCircle::Serialize (CArchive& ar)
{
    if (ar.IsStoring ())
        ar << m_rect;
    else
        ar >> m_rect;
}
```

Since `CCircle` pointers are stored in a `CObList`, the function that serializes an entire document is no more complicated:

```
void CDrawDoc::Serialize (CArchive& ar)
{
    m_list.Serialize (ar);
}
```

`CObList::Serialize` serializes the `CCircle` objects referenced in the list by calling each object's `Serialize` function one by one.

This elementary serialization support serves `Draw1` quite well. The Open, Save, and Save As commands in the File menu are fully functional, and the serialization code works

```
class CCircle : public CObject
{
    DECLARE_SERIAL (CCircle)

private:
    CRect m_rect;
    COLORREF m_crColor; // New
                        // member

public:
    CCircle () {}
    CCircle (LPRECT, COLORREF);
    virtual void Serialize
        (CArchive&);
    virtual void Draw (CDC*);
};
```



FIGURE 3: The modified `CCircle` class declaration used in the `Draw2` application.

```
void CCircle::Serialize (CArchive& ar)
{
    if (ar.IsStoring ())
        ar << m_rect << (DWORD) m_crColor;
    else {
        UINT nSchema = ar.GetObjectSchema ();
        switch (nSchema) {

            case 1: // Version 1
                ar >> m_rect;
                m_crColor = RGB (255, 0, 0);
                break;

            case 2: // Version 2
                DWORD dwColor;
                ar >> m_rect >> dwColor;
                m_crColor = (COLORREF) dwColor;
                break;

            default: // Unknown version
                AfxThrowArchiveException
                    (CArchiveException::badSchema);
                break;
        }
    }
}
```



FIGURE 4: The versionable `CCircle::Serialize` function used in the `Draw2` application.

flawlessly. Everything goes smoothly until you decide to release a new version, called `Draw2`, which includes an important new feature: the ability to draw circles of different colors. This necessitates changing your carefully crafted `CCircle` class so that it includes a `COLORREF` data member that specifies the circle's color. Figure 3 shows the modified class declaration for `CCircle`. `CCircle::Serialize` must change too, so `m_crColor` (the `COLORREF` value specifying the circle's color) will be serialized just like `m_rect`:

```
void CCircle::Serialize (CArchive& ar)
{
    if (ar.IsStoring ())
        ar << m_rect << (DWORD)
            m_crColor;
    else {
        DWORD dwColor;
        ar >> m_rect >> dwColor;
        m_crColor = (COLORREF) dwColor;
    }
}
```

Because the on-disk format of a `CCircle` object has changed, you dutifully change the schema number specified in the `IMPLEMENT_SERIAL` macro from 1 to 2:

```
IMPLEMENT_SERIAL (CCircle, CObject, 2)
```

The `Draw2` application is ready to roll except for one small thing. It will create multicolored

circle drawings and read them back just fine, but if you attempt to load a drawing created by `Draw1` into `Draw2`, you get an "Unexpected file format" message. Clearly this is something your users won't stand for—you must modify `Draw2` so it will also read documents created by its predecessor. This is easily done with versionable schemas.

THE DRAW2 APPLICATION

Modifying an application to take advantage of MFC 4.0's versionable schema mechanism requires two simple steps. First, you must OR the value `VERSIONABLE_SCHEMA` into the schema number assigned to the versionable class in the `IMPLEMENT_SERIAL` macro. Second, you must modify the class's `Serialize` function to call `CArchive::GetObjectSchema` when loading (deserializing) an object from an archive and adapt its deserialization method accordingly.

`VERSIONABLE_SCHEMA` is a bit flag that tells the framework not to throw an exception if the schema of the object in memory and the schema of the object in the archive don't match. `GetObjectSchema` is a `CArchive` member function that returns the schema number of the object that's about to be read or -1 if the schema is unknown. It should be called only once, when an object is being loaded and before any of the object's data members are streamed in. If called a second time, `GetObjectSchema` will return -1.

`Draw2` is an enhanced version of `Draw1` that features a Color menu with a palette of drawing colors. It uses versionable schemas to preserve compatibility with documents created by `Draw1`. The call to `IMPLEMENT_SERIAL` in the `Draw2` version of `CCircle` looks like this:

```
IMPLEMENT_SERIAL (CCircle, CObject, 2
| VERSIONABLE_SCHEMA)
```

The `Draw2` version of `CCircle::Serialize` is listed in Figure 4. The call to `GetObjectSchema` returns the schema number (presumably 1 or 2), and a switch statement activates the appropriate deserialization routine. If the schema number is 1, `m_rect` is deserialized from the archive and `m_crColor` is assigned the default color red.

If the schema number is 2, the object is fully deserialized from the archive. Any other schema number causes `Serialize` to throw a `CArchiveException` so that the framework



could then read the ID number first and call a version-specific input routine to read and initialize the remaining data members.

The drawback to this approach is that it increases the application's storage requirements. MFC is smart about how it writes schema numbers to disk, because it stores the schema number only once, no matter how many objects of a given class the document contains. But adding an extra 4 bytes to each object (assuming you use 32-bit ID values) is a small price to pay to read documents created by previous versions of your application.

ment. After the document is saved once in the new format, the flag should be cleared so that the warning won't be repeated.

Since versionable schemas exist only in 32-bit MFC, adding versionable document support is more difficult if you're writing 16-bit code. One solution is to use the same schema number in all versions of your application and prefix each object serialized into a document with a magic ID that identifies the storage format. The class's deserialization routine

If you weren't prescient enough to include ID numbers in Version 1.0, you can make Version 2.0 work anyway. Identify a value that Version 1.0 could not have written to the first byte, word, or double word of a serialized object and make that value the version ID. If you don't get that number when you read it from the archive, you can assume you're dealing with a Version 1.0 document.

There are other approaches, of course, but none are as seamless as MFC 4.0's versionable schema mechanism. If you're an MFC programmer, versionable schemas are just one more reason to be writing 32-bit code—as if the coming demise of 16-bit operating systems weren't reason enough.

If you have comments on this column, questions about Windows programming, or issues you'd like to see addressed, contact me in the Power Programming section of ZD Net's Tips/Utilities forum on CompuServe. Or send e-mail to 72241.44@compuserve.com. I can't answer all your questions individually, but I'll answer some of the most pertinent and interesting ones here. □

Jeff Prosis is a contributing editor of PC Magazine.

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PC Tech/Internetworking

By Sean González

Sound Foundations: Audio on the Web

The pros and cons of Web-based streaming audio technologies.

If your Web experience is limited to text and graphics, you're missing out on its true multimedia power. Until now, bandwidth limitations and the large size of audio files made it impossible to use the World Wide Web for efficiently and reliably accessing large volumes of archived audio content. Live audio across the Web was simply out of the question. The most you could expect was a quick greeting or a simple message, usually no more than a few seconds of sound.

This almost-silent picture is changing fast. Newer technologies make efficient use of the bandwidth available, which in turn makes it possible for you to enjoy the sounds of the Web, even with 14.4-Kbps modem connections (although you really want to use 28.8 Kbps for improved audio quality and playback). These technologies also go beyond the mere delivery of audio files to your multimedia-enabled desktop by providing the controls you're used to using with conventional audio playback systems. You can now forward, rewind, seek, and pause audio files in real time. We'll look at how three current audio technologies work and examine their strengths and drawbacks.

NO-WAIT SERVICE

One of the most annoying facts of Internet life we have lived with until now is the ridiculous delay involved in downloading large audio files—and most audio files are huge. Audio files have an average 5:1 transfer ratio over dial-up connections; that is, for every minute of audio playback time, you have to wait 5 minutes in download time. Therefore, if you wanted to download a 30-minute radio program, you would have to wait 150 minutes before you could start listening to it.

If you pay to access the Internet, imagine what the cost would be—and your frustration when you find out a few minutes into the program that you aren't really interested in hearing it. And don't forget about the disk space required to store 30 minutes of audio. What's

more, should any problems occur at any point during the download, the entire file will be lost. In short, using conventional technologies (like FTP followed by an audio player) to download audio files and access them off-line is not an option.

To address these issues, companies like Progressive Networks (<http://www.realaudio.com>), VocalTec (<http://www.vocaltec.com>), and Xing Technology (<http://www.xingtech.com>) have designed and implemented audio technologies that allow you to listen to audio files *while* you download them. You don't need to store the file on your local drive either, so you can still lis-

ten to the lower connection speeds, which are more susceptible to packet loss.

Progressive Networks' RealAudio technology delivers superb audio with packet loss rates of up to 4 percent. RealAudio's algorithm to deal with packet loss rates between 4 and 10 percent attempts to predict what the lost packet information was, producing audio similar to that from faint short-wave radio signals. In some cases, this effect can add a strange undertone to the audio you receive. Still, this fill-in-the-gaps technology can avoid choppy audio, making it easier to listen to audio files even at high packet-loss rates.

VocalTec's I-Wave and Xing Technology's StreamWorks technologies are less forgiving than RealAudio. Packet loss is more noticeable, resulting in choppy audio at packet-loss rates greater than 5 percent. Given a good-quality connection, however, all these technologies deliver crisp audio to your desktop via the Internet.

HOW THEY WORK

The predominant audio technologies on the Web, including those from the vendors mentioned, all rely on buffering, codec (compression/decompression), and audio streams technologies. They differ mainly in the algorithms they use to implement these technologies as well as in the way they deliver the audio data

(that is, via UDP, TCP, or IP multicasting).

Buffering is responsible for the 1- to 2-second delay that occurs before you can start listening to audio and every time you reposition playback within a file (that is, every time you fast forward, rewind, or seek an audio file). By allocating portions of memory to store a few packets of audio information (usually a dozen or so), the audio player can achieve very smooth playback. As each audio buffer is played, it is refilled with new data received from the server; the player always finds data to play from the buffer versus having to wait for the server. The assumption is that the

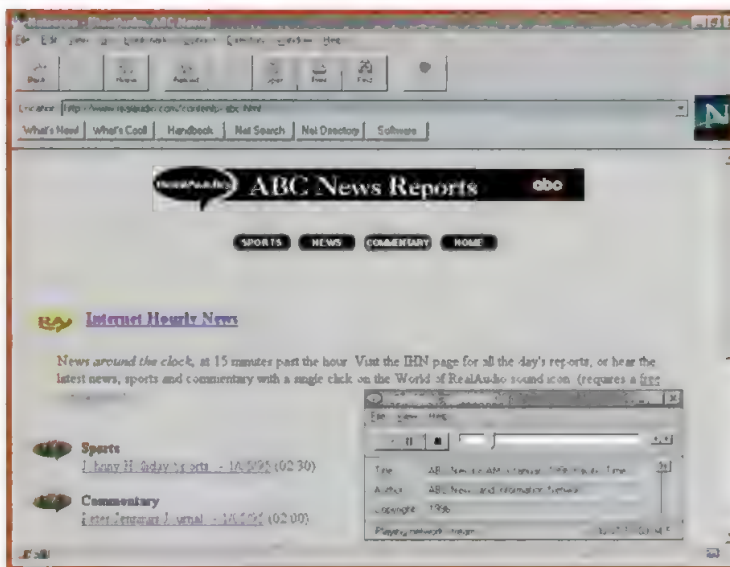
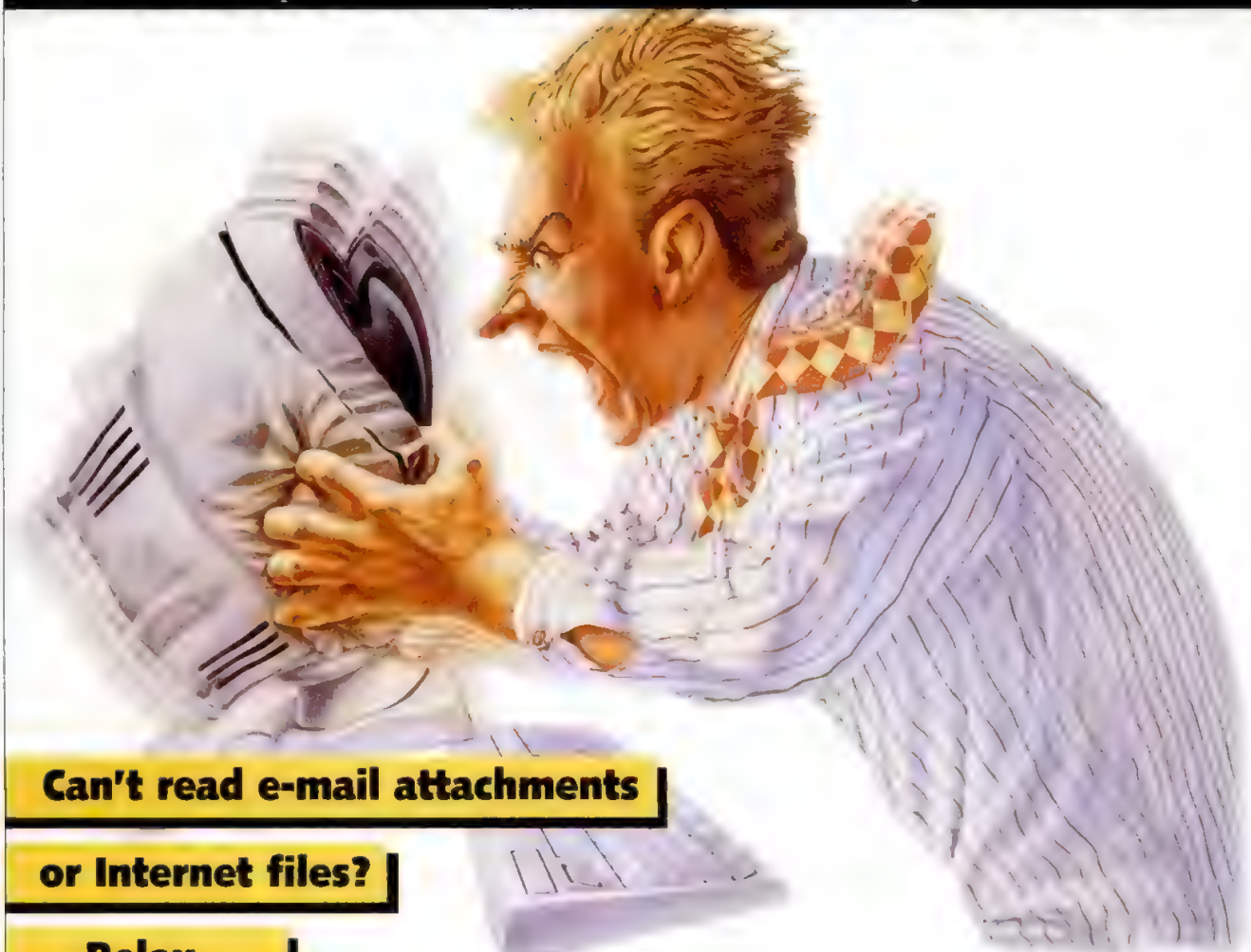


FIGURE 1: RealAudio supports requests for specific packets, letting you move forward or backward within the audio file once playback has started.

ten to that 30 minutes of audio no matter how limited your hard disk space. Usually, after only several seconds' delay, you can start listening to the audio file you want. Skipping to any point in the audio file is also possible, so you can get past the boring local news and go straight to the sports section in no time.

CONNECTION SPEED AND QUALITY

Although you can use these new technologies at any connection speed greater than 9.6 Kbps, your connection speed will determine the maximum possible quality you can attain. Also, the connection quality makes a difference, partic-



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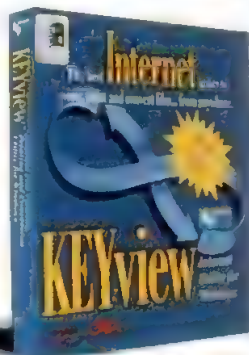
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buffer will make up for transmission delays, which could result in audio gaps until new data is delivered to the player.

Like modem (modulator/demodulator) technologies, codec technologies do something to the data, transmit it, and then undo what was done before transfer. In this case, codec technologies compress the data in the most efficient way possible using the vendors' compression algorithms. Some compression algorithms are better than others, so while the underlying technologies used by all vendors are similar, each can achieve dramatically different performance depending on its codec technology (although overall performance is determined by the way all of its intervening technologies are implemented).

Audio stream technology allows for real-time repositioning within a file as well as playing audio files as they are downloaded. Until now, an entire audio file had to be present before the audio player could recognize and play it. In audio stream technology, the minimum unit of audio is a single packet of data. The audio stream player can therefore play an audio packet as soon as it is received. Furthermore, the player can request a specific audio packet from the server, because in audio stream technology the transfer communication is bi-directional (that is, the server not only transmits data to the player, but the player can transmit data to the server). This request capability enables the fast forward, rewind, and seek features of audio stream players (see Figure 1).

UDP, TCP, AND IP MULTICASTING

The remaining intervening technology is the actual transmission mechanism used by each vendor. Each of the three vendors we looked at has its own philosophy about which transport mechanism uses available bandwidth most efficiently. Because of the architectural design of the protocols used on the Internet (based on TCP/IP), the Internet is not an efficient medium to handle continuous, time-based information. Therefore, the way data is transmitted across the Internet and the protocols used have a direct impact on overall efficiency, reliability, and performance.

Progressive Networks' RealAudio product uses the User Datagram Protocol (UDP). UDP is a maintenance protocol that transmits small packets very quickly (at a high priority) but does not guarantee packet delivery. Therefore, while UDP is perhaps the most efficient way to transmit audio streams, it introduces packet loss, which must be dealt with by the application that uses it. But UDP was never intended to transmit large volumes of data; whenever it is used for that purpose, it tends to saturate communication lines. For example, NFS (which also uses UDP) usually calls

for a dedicated link between the NFS server and client to avoid saturating the network with NFS traffic. UDP is efficient and fast for single point-to-point communications, but it should never be used without some flow-control mechanism that limits its use of available bandwidth; otherwise, UDP-based applications can saturate the network (even the Internet) if used extensively.

VocalTec's I-Wave product uses the Transmission Control Protocol (TCP). TCP is the

most common protocol on the Internet and is used to transmit large volumes of data with guaranteed packet delivery; it also incorporates flow-control mechanisms that help ensure fair resource utilization for all users on the Internet. Packet size is usually larger than with UDP packets to accommodate the transmission of large volumes of data.

Under IP multicasting, the server needs to send the audio stream only once to all computers, and it also uses the most efficient mechanism available to accomplish the task. In general, UDP is best used in momentary audio-delivery applications such as Internet phone products. TCP strikes a happy medium, perhaps the best all-purpose solution despite its inherent limitations due to packet size and retransmission factors. IP multicasting is ideal in situations where the same audio stream will be delivered to many people simultaneously. While there's no clear winner at this time, we have good solutions to meet specific needs.

HEARING AIDS

When using audio-based applications on the Web, you'll doubtless run into problems at some point or another. The most common is choppy audio, caused by packet loss. Make sure you are using the fastest modem connection you can get;

even if your phone line quality is not particularly good, the higher speed can help make up for it (assuming you are not using a UDP-based product, where packet loss cannot be corrected beyond a certain point). Also, a fast CPU will help process the audio signal faster, leaving more time for the CPU to handle incoming data.

Expect to get lower quality out of live audio applications such as video-conferencing products. Particularly with video conferencing, you have very limited bandwidth to handle both video and audio, so audio packet loss is more noticeable in the form of choppy audio. Another contributing factor is that it is more difficult to handle live audio than recorded audio, which can be precompressed. Although codec technologies are getting better by the hour, the time it takes to compress live audio represents a significant delay, which can result in lost packets. Because of the high demands of compression on-the-fly, live audio (as well as video) is one of the toughest challenges to resolve on the Internet.

Although you will run into some problems in the short term, audio on the Internet is a reality you can enjoy today. Many sites already offer audio on demand, including news, special programming (such as interviews, concerts, and documentaries), and music. Be aware of the limitations of the technologies available; for the short term, you will probably want to use a couple of different products to access all the Internet has to offer. As improved versions of today's products are released, however, expect better performance, reliability, and quality. □

Sean González, a regular contributor to our Internetworking column, is a project leader for the Internetworking Solutions group at Information Access Center in Boston.

CONNECTION SPEED AND SOUND QUALITY

Connection type	Speed	Best audio possible
Dial-up modem	9.6–14.4 Kbps	8 kHz (mono, telephone or AM-radio quality)
Dial-up modem	28.8 Kbps	16 kHz or 22 kHz (mono)
Frame relay/dedicated line/ISDN, one B channel	56–64 Kbps	16 kHz or 22 kHz (stereo) or 44 kHz (mono)
ISDN, two B channels	128 Kbps	44 kHz (stereo hi-fi)
Fractional or full T1	384+ Kbps	VHS quality

A major drawback of TCP in dealing with audio streams, however, is that if a packet is lost, the server will need to retransmit it. And because the packet is significantly larger than a UDP packet, it also takes longer to retransmit. Therefore, while a lost UDP packet results in a tiny gap in the audio transmission, a lost TCP packet knocks a huge hole, probably causing audio playback to stop until the packet is retransmitted and successfully delivered. This packet retransmission also results in higher overhead on the server than UDP-based solutions.

Xing Technology's StreamWorks product uses IP multicasting: A *host group* is created, and every IP datagram sent by the server is received by all members of the host group. Membership in a host group is dynamic; your desktop computer becomes a member of the host group while you are accessing an audio stream server.

In IP multicasting, all IP datagrams are delivered using the same "best-effort" reliability used with regular unicast IP datagrams (those sent to a single host). Because of the properties of IP multicasting, the server reduces the overhead required to manage point-to-point communications with single hosts. This information-delivery mechanism is particularly useful when dealing with scheduled programming or live audio; in either case, the expectation is that many people will listen to the same audio at the same time.

Hey!

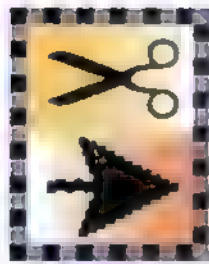
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PC Tech/Utilities

By Tom Rawson

Find Lost Files and Text with WSearch

Add regular-expression searching to Windows and OS/2.

Have you ever needed to find a file with a certain pattern of characters in its name? Perhaps you've installed Microsoft Windows 95 with its long filename support, but now you can't remember if you called the file Resume or My Resume. Or maybe you need to find a certain bit of text you know is somewhere on the hard disk. Finding files and text is what this issue's utility, WSearch, is all about.

When you need to find a file with native Windows 3.x tools, you're limited to File Manager's Search function, which uses DOS-style wildcards, and you can't look for text. OS/2 provides more flexibility in file-search criteria, but you can't look for text, either. Windows 95 does better with its Find tool, accessible from the Start button's context menu. Find can search for text within files, but there must be an exact match (not even wildcards are accepted), and there are other limitations as well.

WSearch enhances both file and text searches with a powerful method called *regular expressions*. This offers a compact way to specify a pattern of text you would like to match. The DOS wildcard characters * and ? are part of regular-expression capability, but they're only the tip of the iceberg. Let's say you want to find a file containing the string *noodles*. That's not too difficult, and the Windows 95 Find utility can do it. But what if you want to find any string that starts with *n*, has a vowel plus two additional characters following, and then ends in *les* (for example, *needles*, *nipples*, *nodules*, *noodles*, *nozzles*, and *nuzzles*). Or what if you want to find all files that contain the words *breach* or *broach*? Find cannot do this; WSearch can.

Regular-expression syntax was developed under Unix and underlies utilities named GREP or some derivative thereof like FGREP or EGREP. GREP stands for Global Regular Expression Print, referring to the ability to apply a regular expression globally (across a file or multiple files) and print the results. A full implementation of GREP can search for repetitions of characters and perform other complex tasks. But many GREP utilities, including WSearch, implement only a subset of the regular-expression syntax.

One unusual feature that WSearch adds to

the standard GREP toolkit is the ability to use the same syntax to search for filenames. You can search files whose names match one pattern for text that matches another pattern. This makes WSearch an extremely powerful search tool.

WSearch includes two Windows executable files: WSWIN.EXE for Windows 3.1 and WSWIN32.EXE for Windows 95 and Windows NT. The Win32 executable supports long filenames. I originally built and tested WSearch as an OS/2 command line utility, so the package also includes WSOS2.EXE, a 32-

Checking the "Search subdirectories" option tells WSearch to search the current directory (or any directories you name in the Files box) and all its subdirectories. If this box is not checked, only the current and/or specifically named directories will be searched. If you enter a root directory in the File(s) edit box, checking "Search subdirectories" will search an entire drive.

If you check the "Case sensitive" option, the case of the search text will have to match the case of text in the file exactly for it to be considered a match. Otherwise, case variations are ignored during the search. Note that this applies only to text searches; filename searches are always case-insensitive.

By default, WSearch will list only files that contain a match to the search text. If you check the "Show files that don't match" option, files with no match will be displayed in the results box with the message "*** No match ***".

Sometimes a file will contain more than one match to the search pattern. Normally WSearch lists the first matching line only. If you check "Show all matches," WSearch will list all the lines that match in each file.

By default, WSearch does not display line numbers in the results list. These are optional because the search goes a little faster when WSearch doesn't have to count lines. You can tell WSearch to display line numbers by checking the "Line numbers" option.

The "Fast response" option improves response to the Stop button, at a slight cost in search speed. Under Windows 3.1, checking this box also gives more chances for other applications to run while a search is in progress.

You can enter paths, filenames, or both in the File(s) edit box. If you use only a path, WSearch will search all files in the specified directory. You can specify multiple filenames or paths by separating them with spaces or semicolons. When searching multiple file specs, WSearch starts by looking through the first one (including subdirectories, if this option is checked) and then moves on to the next one. If you don't enter any paths or filenames, the search starts from the current directory, which is displayed at the top of the dialog box.

WSWIN32 and WSOS2 support long filenames and require double quotes around any filename

IN THIS ISSUE

WSearch

A file- and text-search tool that supports wildcards in both the filename search field and the text string search field. It is available in Windows 3.1, Windows 95, and OS/2 command line versions.



bit OS/2 command line version with the same capabilities. You can obtain WSearch and its Watcom C source code from PC Magazine Online or by mail. (For details, see the sidebar "Guide to Our Utilities.")

USING WSEARCH

Installing WSearch is easy—just copy it to a directory on your hard disk and create a desktop icon for it. When you first launch WSearch, you'll see a simple dialog box (Figure 1). The two edit boxes at the top of the screen let you enter the filenames to search for and the text, if any, to search for within the files. Below the edit boxes are six check box options that control how WSearch performs the search and displays the results. The options are Search subdirectories, Case sensitive, Show files that don't match, Show all matches, Show line numbers, and Fast response. Below the options check boxes is a window for displaying the search results.

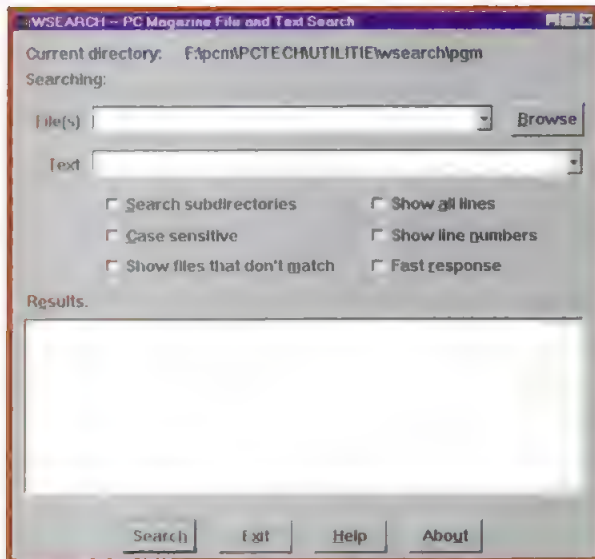


FIGURE 1: WSearch uses a simple dialog box for entering search criteria and displaying the results.

that includes spaces (for example, "Goulash Recipe"). Short filenames and long names without spaces (GoulashRecipe) don't require quotes, but you can use them if you wish.

Unlike the File(s) edit box, the Text edit box can contain only one search pattern. Any spaces in what you type are assumed to be part of the pattern. You can use quotes around the search pattern if you wish, but they are not required. If you don't specify a Text search pattern, WSearch will list all the files that match the File(s) pattern and will ignore the text within the files.

You can use WSearch to do simple searches with wildcards without learning regular-expression syntax. For example, to search all *.DOC files for the string "Mabel", you would enter "*.DOC" in the File(s) edit box and "Mabel" in the Text edit box.

After entering the search information in the dialog box, press Enter or click the Search button and the search will start. The Searching line at the top of the window displays the search status, and results are displayed in the Results box. You can use standard navigation keys to scroll through the Results list box. While a search is running, the Search button changes to a Stop button and the Exit and Help buttons become unavailable. Clicking Stop or pressing Enter during a search will halt the search. If you restart the search, the list box clears and the search starts over.

REGULAR-EXPRESSION SYNTAX

So far I've only told you how to use WSearch in the same way as any Find utility. But its real power is its ability to use regular-expressions. The regular expression syntax used by WSearch is simple but powerful.

When you specify a pattern for WSearch to match, most characters are treated literally.

For example, an "a" in the pattern just means the letter "a", and a "(" means a left parenthesis. But certain characters, such as the wildcard characters * and ?, have a special meaning to WSearch. These special characters are called *meta-characters*, because they have a higher-level meaning than plain text characters. Figure 2 shows the meta-characters WSearch uses and their meanings.

As described in Figure 2, strings in square brackets are called *character classes*. Whether a character is interpreted as a meta-character depends on whether it's in a class and sometimes on its relative position. Outside a class, the characters with special meanings are <, >, ?, *, [, and].

The special characters used within classes, ~ and -, are interpreted as normal characters when they occur outside a class. For example, outside a class, the pattern ~abc would be interpreted literally, with no special meaning for the ~. (Also, the ~ character carries a

the search string. We need a way to ignore that special meaning and treat the question mark literally.

This is a common problem when text contains special characters, and it has a common solution. If an Escape character precedes a meta-character, the meta-character is treated literally, as plain text. WSearch uses the caret (^) to indicate the Escape character. So, for example, you would use "^?" to search for a question mark. To put a caret in the text, use two carets (^ ^). (Note that the WSearch Escape character is not the same as the ASCII ESC character.) Many programs follow the C programming language convention of using a backslash to indicate Escape. I chose the caret instead, because using the backslash would substantially complicate one of WSearch's important features, the use of regular expressions to specify filenames.

The Escape character has a second use in WSearch: It lets you specify characters that normally can't be used in a search pattern because they are nonprinting—for example, the carriage return or line feed characters. WSearch recognizes five Escape sequences (see Figure 3). If the Escape character is followed by a character other than the ones listed in Figure 3, WSearch ignores the Escape

META-CHARACTERS USED BY WSEARCH

Character	Function	Example
?	Matches any single character except the end-of-line character.	"a?" matches "abc", "abc", or "a#c".
*	Matches any character or string except the end-of-line character; it also matches no character.	"a*c" matches "alphabetic", "all plastic", or "AC".
[abc...]	Matches any character listed within the brackets (called a character class). In case-insensitive searches, letters in a class include the upper- or lowercase equivalents.	"[aBc]" matches a, b, c, A, B, or C for case-insensitive searches.
[a-z]	Matches any character in the range, including the end characters, using standard ASCII values. You may need an ASCII chart to understand unusual ranges.	The range "[0-2]" also includes many punctuation characters.
[~abc...]	Matches any character except those in the brackets or those not part of the range.	"[~a-z#]" matches all characters except a, f, w, x, y, z, and #.
<	Matches only if the character or string occurs at the beginning of the line.	"^app" matches "apple" but not "happy".
>	Matches only if the character or string occurs at the end of the line.	"and\$" matches "hand" but not "handle".

FIGURE 2: Regular expressions use meta-characters with special meanings. These are the meta-characters that WSearch recognizes.

special meaning only when it is the first character in the class; otherwise it is taken literally.) Characters such as ? and * that have a special meaning outside a class are interpreted as plain text characters when they occur within a class. For example, the pattern [xyz*~] would match the characters x, y, z, *, or ~.

If you think about the WSearch syntax for a minute, you'll realize that it has a small problem. Suppose you'd like to search some files for the string "Where are you?". The "?" has a special meaning to WSearch and won't have the desired effect if it's simply included in

and uses the following character literally, even if it is a meta-character. The examples below show how the Escape character is used:

^[Boot^]	Searches for "[Boot]".
abc^ndef	Searches for "abc" on one line and "def" on the next.
3 ^^ 6	Searches for "3 ^ 6".

AN EXAMPLE

Let's apply these rules to an example. The following expression uses several of the possible elements in a WSearch expression:



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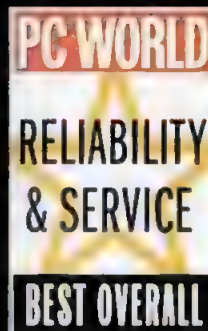
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no[aeiou]?[~g-j]*e

Let's decode the five pattern elements in this expression and look at what they mean to WSearch:

- no: Matches the literal characters "no".
- [aeiou]: Matches a single character that is a vowel.
- ?: Matches any single character.
- [~g-j]: Matches any character that is not between g and j.
- *e: Matches the literal character "e".

The "*" is not a search element in itself, but it tells WSearch to allow any number of additional characters on the line between the previous element and this element. If the "*" were not present, the match would fail unless an "e" immediately followed the previous element.

Now let's look at how WSearch tests several possible text lines against the pattern shown above (no[aeiou]?[~g-j]*e). Assume each sample text string appears in the file on a line by itself:

- Noise—"No" matches no in the pattern. Since "i" is a vowel, it matches the [aeiou]. The "s" matches the ? in the pattern. The "e" is not a character between g and j, so it matches [~g-j]. But at this point we've used up the line, so there's nothing to match the *e, and the match fails.

- Noise noise—This line will proceed just like the line above, but the * in the pattern will skip over "nois" and the final "e" will match, so the line matches.

- No noodles—The match fails at first, because the third character is a space and not a vowel. WSearch will restart the search after the space, however, and the first four elements of the pattern will match "noodl". You might

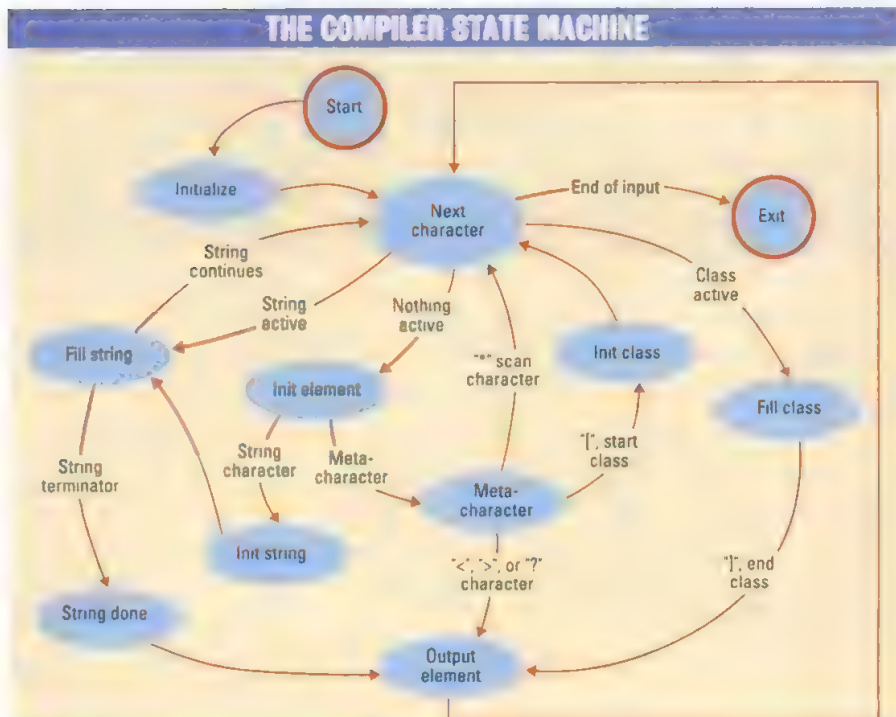


FIGURE 4: The compiler state machine, diagrammed here, translates the search pattern into a form that allows speedy matching.

characters match, but "h" is between g and j, so it fails to match the [~g-j] part of the pattern.

SPECIFYING FILENAMES

When you use a regular expression in the File(s) box, WSearch retrieves the name of each file in the directory and tests it to see if it matches the pattern you've specified. For example, the regular expression [abc]*y.*

will find all files with any extension whose names begin with a, b, or c and end in y.

You can use a regular expression only for the filename and extension. Regular-expression characters in the path portion of the filename (the part before the final backslash) will be ignored as meta-characters and treated as though they

are part of the path. If the path (or filename) is invalid, you will get an error message from the operating system.

When you use a regular expression to match a filename, WSearch assumes the first character in the expression must match at the start of the name and the last character must match at the end of the name. For example,

the pattern [abc]*t will match the file ADMIT, but it will not match MARY.DAT (because the name does not begin with a, b, or c) or ARMPITS (because it does not end with t). To match the specified string anywhere within a filename, add a * at the beginning and end (for example, *[abc]*t*).

Note that this is different from how text expressions are handled. In text expressions, the angle brackets, < and >, are used to anchor searches to the first or last character of a line. This difference is necessary to make WSearch's behavior consistent with the way filenames are usually handled. If filename patterns were not anchored to the beginning and end of the name, a pattern like XY? would match, for example, ABXYZ, which is not what the user would expect.

When WSearch tests filenames, the entire name—including the period and any extension—is treated as a string and matched against the expression you specify. This is slightly different from the typical wildcard matching you may be used to, where the name and extension are treated separately. For example, in WSearch the filename pattern a?y matches names that begin with the letter "a," followed by any character, followed by the letter "y". This would match a file named ANY or one named A.Y; the "." between the extension and the filename is simply treated as another character. Avoiding the artificial division between name and extension makes the filename search patterns much easier to understand.

ESCAPE SEQUENCES RECOGNIZED BY WSEARCH

Sequence	Meaning
^t	Tab character (ASCII 9)
^r	Carriage return character (ASCII 13)
^n	Line feed character (ASCII 10). During searches, this also matches a carriage return/line feed pair.
^ddd	Numeric ASCII character ddd (decimal). The three characters after the ^ are considered to be the number, but a one- or two-digit number can be used if the following character is not a valid decimal digit.
^xdd	Numeric ASCII character dd (hex). The two characters after the ^ are considered to be the number, but a one-digit number can be used if the following character is not a valid hex digit.

FIGURE 3: The Escape character, indicated in WSearch by a caret, lets WSearch recognize five types of Escape sequences.

think the match would fail at this point, because only the "e" is left in the text to match the *e in the pattern. But an asterisk can also match no text at all, so in fact this test succeeds, and the line matches.

- Noggin—This line fails, because "g" is not a vowel.
- Nought—This line fails. The first four

THE WSEARCH COMMAND LINE

Yes, Virginia, Windows applications do have command lines! The command line is what goes in the Parameters box when you create the icon for the program under Windows 3.1. The Windows 95 equivalent is the Target line on the Shortcut page of the Properties dialog box.

You can specify a filename, a text string, and any of the six WSearch options using switches on the command line. Command line switches can be preceded by either a dash (-) or a slash (/). The command line syntax is shown below. Note that the command to launch WSearch will differ depending on whether you are running the 16-bit Windows version, the 32-bit Windows version, or the OS/2 version:

```
WSearch-command [search options]
[-t] text-expression [-f] file-
specification [-g]
```

For 16-bit Windows, the WSearch command is WSWIN; for 32-bit Windows it is WSWIN32; for OS/2 it is WSOS2.

The search option switches are:

```
-a    Show all matches
-c    Case-sensitive
-m    Show files that don't match
-n    Show line numbers
-s    Search subdirectories
-r    Fast response
```

The -t and -f switches are not necessary if a text expression precedes the file specifications. If you want to omit the text expression, or if you want to put the file specification before the text expression, the -t and -f switches let you do this. Their meanings are:

```
-t    Text expression follows
-f    Filespec follows
```

For the Windows versions of WSearch, the command line switches serve to initialize the values in the WSearch dialog box. You can then change or add information and start the search manually. If you prefer, however, you can tell WSearch to run immediately by using the -g (go) switch. If you use -g, the dialog box will be filled with the information you specify on the command line, and then the search will be initiated automatically. (The -g switch is not used in the OS/2 version, since it's implied for a command line utility.)

INSIDE WSEARCH

I had several design goals when developing WSearch. I wanted the program to be simple enough to use that you could call it up quickly for short tasks. I wanted a search capability with enough power that it would be noticeably more useful than the tools that come with Windows. I wanted it to be fast enough to be useful, but I didn't want to worry about devel-

oping the fastest search engine on the planet. Within reason, I didn't care how big the program got, as long as it was fast. I wanted it to be very easy to port to new platforms. Finally, I wanted to demonstrate some interesting techniques for programmers.

A little thought and research made it clear that the best choice for the matching engine was a program based on *state machines*. A state machine is an imaginary machine that can be in any one of a finite number of states. When the machine receives new input, it shifts into a different state. If the machine has a task to perform, there is usually a "start" state and a "finished" state. State machines, also called

"actions." For example, I describe a "state" called "Initialize element." This could be reworded to sound more statelike, but I chose clarity over purity. The divergences from theory in WSearch, which are reflected in both the state diagrams and the code, are there to make the program simpler, faster, or both.

WSearch is based on two state machines, both contained in the file WSEARCH.C. The first, in the procedure Compile, analyzes a regular expression and "compiles" it into an internal form that can be tested quickly against text. It handles all the issues of interpreting meta-characters and Escape characters, finding the beginning and end of charac-

```
typedef struct _ELEMENT {
    int nType;                // element type
    int nLength;              // length to match
    int fScan;                // TRUE to scan line for match
    int flupper;              // TRUE if element is case-sensitive
    union {
        UCHAR chr;           // single character to match
        UCHAR *pString;       // pointer to string, or to class array
    } text;
```

FIGURE 5: The internal representation of the search pattern is held in the variable *Pattern*, which is an array of data structures of type *ELEMENT*.

finite state automata, are among the earliest concepts developed in the field now called computer science. For more information, refer to a textbook on theoretical computer science.

State machines are easy to understand if you have good diagramming tools, easy to program once the diagramming is done, and typically very fast to execute. They are ideal for situations where multiple inputs can generate a range of possible events and actions that don't hook together into an obvious, logical flow. In many situations amenable to a state machine, if you tried to use standard procedural programming you'd likely find yourself embedded in spaghetti code, spaghetti data, or both.

In WSearch, the "inputs" that shift the state machine into different states are the different components of the search pattern as they're scanned and the contents of the text being searched as it's read in. As the search progresses, new characters are processed from the search pattern and the text file, and WSearch must respond differently depending on the nature of this input. Since the events in WSearch depend on the patterns of characters in a particular search expression or text string, the flow of logic is unpredictable.

I used state machine theory as a starting point for developing a clearly coded and efficient algorithm for WSearch. My first goal, however, was to write a good program rather than implement a theoretically pure state machine. Purists will note that WSearch's state machines diverge somewhat from theory. In particular, my definition of *state* is somewhat loose and includes what might be considered

ter classes and making sure the expression is legal. The second state machine, in the procedure Match, is the pattern matcher itself.

Each machine is based on a state diagram. In fact, I worked out the design of the compiler and matcher algorithms in their entirety using these diagrams before writing any code. Figure 4 shows the state diagram for the compiler. (The state diagram for the matcher is not shown here, but it's included with WSearch's source code.) I developed the diagrams with Visio Technical, which made modification very easy as the design changed.

Each oval in the state diagram represents a state, and each line represents a condition that causes a change of state (a transition). Arrows without legends represent transitions that always occur; otherwise, the legend tells you what causes that transition. The legends don't show all the logic, but they give you a feel for what each state is and how the machine can get in and out of it.

Each state machine consists of a simple for loop enclosing a switch statement. The state variable *nState* holds the current state, and the loop continues until *nState* is set to an exit value. Each time through the loop represents a single state transition.

THE COMPILER STATE MACHINE

The compiler translates the regular expression into an internal form that lets the matcher compare it against the text without reexamining the expression each time it's used (a process that would seriously compromise the speed of the program). The internal representation is held

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in the variable Pattern, an array of data structures of type ELEMENT (see Figure 5).

The compiler cycles through the expression and converts each element into an entry in the array. An *element* of the expression is any single character, string, class, or the meta-characters ?, <, or >. The element type is stored in the nType structure member, and the other data shows the actual content of the element.

You may have noticed that the * character is not listed as a pattern element. That's because it is not an element in itself. The * tells the matcher to scan through the line for the next element rather than requiring it to be adjacent to the previous element. When a * is found in the pattern, WSearch sets the fScan flag in the data structure for the next element to TRUE, which tells the matcher to perform the scan.

The way character classes are compiled shows how the compiler can make the matcher's job much easier. When a class is found, the compiler reserves a 256-byte class array, stores a pointer to the array in the data structure, and initializes the array to all 0s. The last bit of each byte is then reversed if the corresponding ASCII character is found in the class. For example, an A toggles byte 65, because the character A has an ASCII value of 65. For case-insensitive matches, the compiler toggles both the upper- and lowercase values whenever either character is included in the class.

The result is a class array with each byte set to 1 if the corresponding ASCII character matches the class. This allows the matcher to use a character from the text as an index into the array; if the value found is 1, the text matches. This is much faster than comparing the text character with a list of characters that are (or are not) in the class. Fast indexing is also the reason why the class array consists of 256 bytes rather than 256 bits.

Case-sensitive searches are faster than case-insensitive searches, so WSearch attempts to perform case-sensitive searches whenever possible—even when the case-sensitive option is not checked. The fUpper flag tells WSearch whether any character in the element has different upper- and lowercase values. This is true for alphabetic characters, but not for numbers. If the upper- and lowercase values are the same—for example, if the

element is a string of numbers—the fUpper flag is not set and the faster case-sensitive search method is used.

The Compiler state machine spends most of its time moving between the Next character state and some other state. Each character retrieved from the pattern is passed to one of three handlers. If the previous character was a text character, the compiler is accumulating a

string, and the Fill string state is next. Similarly, if a class is in the works, the Fill class state handles the character. If no string or class is active, the character represents the start of a new pattern element and is handled in the Init element state. Init element determines whether the character is a meta-character or the start of a string and invokes the appropriate next state.

Sometimes the compiler has to back up slightly. For example, in the pattern

abc[d-f], the Fill string state will be invoked with the [character and the compiler will recognize that the string has ended. This causes a transition to the String done state, where the string is stored. String done then sets the fUse-Current flag, which tells Next character to reuse the current character (the [) rather than retrieve a new one.

When the compiler is finished, it passes back the variable nElements, which tells the caller how many elements were found in the pattern. The matcher uses nElements to scan the pattern.

THE MATCHER STATE MACHINE

The matcher's job is to take the compiled expression and find matching text in a file. As a secondary function, the matcher can also compare the pattern to a string in memory; this feature is used to handle regular expressions within filenames.

The matcher state machine is too complex to describe in detail here, but I will provide an overview of how it works. Take a look at the source code if you would like to know more about it. The code is well commented, and the state diagram is included with the source code.

The fundamental cycle of the matcher is to retrieve a buffer full of text from the file and scan through it for a match. Once the first element of the search pattern matches, the matcher proceeds to match each element against the text from the file. If it finds the end

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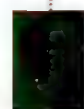
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of the search pattern, the match is successful.

In addition to matching, the matcher has two other tasks: It must display the results of the match and, in a message-based operating system like Windows, it must yield control so that its own or other windows can receive messages (including those from the Stop button!). These functions are handled by two external procedures supplied by the main program code, WSDispResult and WSYield.

WSDispResult is called whenever the matcher has something to display. Under Windows this procedure simply adds the display string to the Results list box. Making WSDispResult an external procedure is a key to making

WSearch work in multiple environments. A command line implementation of WSearch can implement WSDispResult as a simple "puts" call (for an example, see WSOS2.C).

WSYield contains WSearch's message loop. The message loop is placed in a separate procedure so that it can be called during the search process, a somewhat unusual design. Another unusual aspect of the message loop is its ability to loop continuously (if called with a TRUE argument, as it is from WinMain) or to process all messages and exit (if called with a FALSE argument, as it is from the code in WSEARCH.C). The result is a single loop that can handle all the messages but lets back-

ground work keep going.

WSearch is an extremely powerful search utility that goes beyond what is provided with Windows 3.1, Windows 95, or OS/2 Warp. You can use it to search for files, text, or both, and it supports regular expressions in its searches. Implemented with state machines, a classic and very powerful programming technique, WSearch offers something for both end users and programmers. □

Tom Rawson is president of JP Software and coauthor of the company's command line tools, 4 DOS, 4OS2, 4 DOS for Windows NT, and Take Command.

GUIDE TO OUR UTILITIES

ABOUT WSEARCH...

PURPOSE WSearch is an extremely powerful utility for searching files, text, or both. It supports regular expressions in both the filename search field and the text string search field. This lets you, for example, search for all files with the file type .DOC or .XLS containing the text strings "breach" or "broach". Versions of WSearch are available for 16-bit Windows, 32-bit Windows, and OS/2. The OS/2 version is command line only.

USAGE Installing WSearch is easy—just copy it to a directory on your hard disk and create a desktop icon for it. When you first launch WSearch, you'll see a simple dialog box. The two edit boxes at the top of the screen let you enter the filenames to search for and the text, if any, to search for within the files. Below the edit boxes are six check box options that control how WSearch performs the search and displays the results. The options are Search subdirectories, Case sensitive, Matches only, Show all lines, Line numbers, and Fast response. See the WSearch online Help file for more details on the options. Below the options check boxes is a window for displaying the search results.

You can use WSearch to do simple searches with wildcards without learning regular expression syntax. For example, to search all *.DOC files for the string "Mabel", you would enter "*.DOC" in the File(s) edit box and "Mabel" in the Text edit box. If you leave the File(s) field blank, WSearch will use the current directory shown at the top of the dialog box. If you leave the Text field blank, WSearch will hunt for the files you specify without looking at their content. For details of WSearch's regular expression syntax, see the online Help file.

After entering the search information in the dialog box, press Enter or click the Search button and the search will start. Clicking Stop or pressing Enter during a search will halt the search. The Searching line at the top of the window displays the search status, and results are displayed in the Results box. You can tab to the Results list or select it with the mouse, then use standard navigation keys to scroll through it.

FILES FOR DOWNLOAD

WSWIN.EXE—The Windows 3.1 version.

WSWIN32.EXE—The Windows 95 and Windows NT version.

WSOS2.EXE—The OS/2 command line version.

WSWIN.TXT—The documentation file.

WSWIN.ZIP—The source code, program, and documentation files.

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PC Solutions

TIPS AND TECHNIQUES TO INCREASE YOUR PRODUCTIVITY

User-to-User

By Neil J. Rubenking

Using Long Filenames With Old Programs

I've been reluctant to use long filenames, since not all my programs are Windows 95-compliant. Those older programs see only a truncated name with a tilde and a unique number, so they can't directly identify the file.

To experiment, I created a file, *testtest.doc*, in Word 6.0, then saved and closed the file. Within Explorer I renamed it "testtest.doc_This is a test." I then double-clicked on the file to see if it would load automatically. Much to my surprise, it loaded directly, without a dialog box asking what program to start it with. I closed the Word file again and then used File | Open within Word and found the name "testtest.doc" in the Word Open dialog box. As a final test I exported the file to a 3.5-inch disk and repeated the experiment. It worked fine.

In Windows 95 Explorer, the long filename is visible and the file loads correctly. What this means is that if you begin with a valid unique 8.3 filename, you won't get the truncated version in Windows 3.1 and it will be able to identify the program associated with the file. Within Explorer you can add some identifying comment after the name, which is useful if you can't remember the 8.3 name. This approach also worked with Excel 5.0.

When you open or save the file in a Windows 3.1 program, the comment is stripped and you are left with the normal 8.3 filename. At least this approach allows you to use long filenames in this transition period from 16- to 32-bit apps.

RAYMOND F. MADDALONE,
Redondo Beach, California

PC MAGAZINE: Windows 95 supports filenames up to 255 characters, but it also ensures that a unique 8.3 filename (eight characters of name, three characters of extension) exists for backward compatibility. To create this alias filename, it removes any spaces, replaces punctuation that's not supported in an 8.3 filename with underscores, truncates the filename portion to eight characters, and appends the extension.

If the resulting alias is unique in the current directory, nothing more needs to be done. Otherwise, Windows 95 replaces the last two or

three characters of the name portion with a tilde and a unique number, leaving just five or six characters of the filename. Creating meaningful 8.3 filenames is hard enough; it's discouraging to have Windows 95 chip away at them.

The secret, as described above, is to make sure your long filename will translate to a name that's unique in the current directory. You must use only characters that are valid in an 8.3 filename, and use the full eight characters for the name portion. I'd suggest one change in the technique, though. Rather than embedding the extension between the first eight characters and the remainder of the long filename, put the extension at the very end. This change won't affect the way pre-Windows 95 programs see the file. The difference is that most Windows 95 programs will not recognize the file extension when it's buried in the filename. Explorer seems to be the main exception; it will recognize the .DOC extension either way.

A specific example should make this point crystal clear. Instead of using the name "testtest.doc_This is a test", you would name your file "testtest_This is a test.doc". Either will be seen as TESTTEST.DOC in an older program, but only the latter will show up in the File Open dialog when you request *.DOC files, and only the latter can be launched successfully using the START command from a Windows 95 command prompt.

Exiting from Windows 95 to DOS

Your issue of November 21, 1995, addressed the question, "Is there a way to exit Windows 95 completely and return to a DOS prompt using the primary command processor without WIN.COM?" The answer you gave, while accurate, was not to the point.

I don't believe the reader was interested in the dual-boot option in Windows 95 or the F8 boot-menu options. Instead, there is a very simple answer: Boot with MSDOS.SYS edited to read *BootGUI=0*, then upon exiting Windows, you can just select the Shut Down... menu option and blind-type *MODE CO80* at the "It Is Safe to Shut Down Your Computer" display.

It may be that Microsoft would rather this fact not be known, as it tends to destroy the

HIGHLIGHTS



HARDWARE Find out if it's possible to convert your old, low-capacity SIMMs to fit into today's high-capacity sockets. *Page 228*



SPREADSHEETS Learn how an Excel macro can retrieve input from the user with Visual Basic for Applications' InputBox function or the method of the same name. *Page 246*



DATABASES A third-party extension for Visual FoxPro can replace most of Beautify's code-formatting capabilities. *Page 252*

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illusion that Windows 95 is totally free of DOS. But this procedure works, and I believe it is the type of solution the reader was interested in.

LESLIE D. MARTIN, Anchorage, Alaska

PC MAGAZINE: According to Microsoft, once the shut-down screen has appeared, the system is in an unstable state; my own experience bears this out. On some systems, typing MODE CO80 at the shut-down screen either has no visible effect or else turns the display to graphic gibberish. On others, the DOS prompt reappears and seems functional, but after a few minutes the system locks up so thoroughly that a cold reboot is required. But some systems do seem to work perfectly after returning to the DOS prompt from the shut-down screen.

If you're fond of experimenting, by all means try this technique—it may work fine on your system. To prepare, you must arrange for Windows 95 to boot directly to the command prompt. Here's how:

Open a command-prompt window under Windows 95 and switch to the root directory of your boot drive. Enter the command

```
ATTRIB MSDOS.SYS -R -S -H
```

and then load MSDOS.SYS into your preferred editor. Look for the BootGUI= line in the [Options] section. If the line exists, change it to BootGUI=0. If not, add the line BootGUI=0 to that section. Save MSDOS.SYS, exit the editor, and then enter the command

```
ATTRIB MSDOS.SYS +R +S +H
```

When you restart Windows 95, it will boot up in command-prompt mode. Type WIN to start the Windows 95 graphical user interface, then select Shut Down... from the Start menu. After the shut-down screen appears, enter MODE CO80 (you won't see what you're typing). This is the moment of truth. If the DOS prompt reappears, you may be a winner. Try performing a series of simple tasks at the DOS prompt. Clean up old backup files, list the contents of several directories, run CHKDSK, or do whatever other DOS-based tasks come to mind. If 5 or 10 minutes of activity pass without a lockup, your system may well be one that supports this method of returning to DOS from Windows 95.

Detecting Windows And Windows 95 from a Batch File

Despite the increasing ubiquity of Windows, many users are still interested in batch files and, in particular, being able to test whether a batch file is running in Windows. And many also wonder whether the

```
:: WINCHK.BAT
::
@ECHO OFF
IF NOT [%1]==[] GOTO Finish
ECHO %0 NOT in Windows. > 0.BAT
ECHO %0 IS in Windows. > 1.BAT
SET | FIND "windir=" /C > {TEST}.BAT
{TEST}
:Finish
FOR %%v IN (0 1 {TEST}) DO DEL %%v.BAT
ECHO %1 %2 %3
```

FIGURE 1: WINCHK.BAT reports whether it is running under Windows.

```
:: WHEREWIN.BAT
::
@ECHO OFF
ECHO SET WINDIR=%1> WINDIR.BAT
SET | FIND "windir=" > WINDIR.BAT
CALL WINDIR
DEL W?ND?R.BAT
ECHO Windows was started from %WINDIR%
```

FIGURE 2: WHEREWIN.BAT copies the Windows directory from the inaccessible windir variable to a variable named WINDIR.

```
:: WINCHK95.BAT
::
@ECHO OFF
IF NOT [%1]==[] GOTO Finish
ECHO %0 DOS> 0.BAT
ECHO %0 Windows> 1.BAT
SET | FIND "windir=" /C > {TEST}.BAT
{TEST}
:Finish
FOR %%v IN (0 1 {TEST}) DO DEL %%v.BAT
SET OS=%1
IF NOT [%1]==[Windows] GOTO Done
ECHO %0 Windows3.1> 0.BAT
ECHO %0 Windows95> 1.BAT
SET | FIND "winbootdir=" /C > {TEST}.BAT
{TEST}
:Done
ECHO Operating system is %OS%
```

FIGURE 3: Call WINCHK95.BAT from other batch files to determine whether they're running under DOS, Windows 3.1, or Windows 95.

"windir" environment variable can be used to find the Windows startup directory. Because Microsoft named the variable in lowercase (to discourage tampering, no doubt), you can't test it with a straightforward IF [%windir%]==[] type of test. This test will not find a lowercase environment variable; nor can the contents of windir be determined by conventional means.

I've developed two batch files to demonstrate how to access the windir variable. The

batch file in Figure 1 (WINCHK.BAT) simply determines whether windir (in lowercase letters) is the name of a variable in the environment. The batch file in Figure 2 (WHEREWIN.BAT) copies the contents of windir to WINDIR, permitting another batch file to access the information. The last line in each batch file just demonstrates the results.

One interesting note is that the WINCHK routine does not use an ERRORLEVEL after the FIND command. It will, therefore, work with versions of DOS earlier than Version 6.0.

TOM LAVEDAS, Clifton, Virginia

PC MAGAZINE: WINCHK.BAT pipes the output of the SET command through the FIND filter, seeking the lowercase string "windir=". The /C switch causes FIND simply to report the count of occurrences, which will be 1 if the batch file is running under Windows and 0 if not. WINCHK.BAT creates the temporary batch files 0.BAT and 1.BAT. When {TEST}.BAT, containing the output of FIND, is executed, it in turn executes 1.BAT or 0.BAT to report whether or not Windows is active.

You can use a similar technique to detect Windows 95. Just as in Windows 3.1, the windir variable is set to the directory containing Windows. In Windows 95, however, another variable, winbootdir (also lowercase), is set to the directory containing the Windows startup files. WINCHK95.BAT (shown in Figure 3) incorporates both tests and sets the environment variable OS to DOS, Windows 3.1, or Windows 95, as appropriate.

Detecting Windows 3.1 is important mainly because certain commands like CHKDSK should be avoided in a multi-tasking environment. Detecting Windows 95 is much more important, because a batch file executing under Windows 95 can launch Windows programs! By default, a Windows program launched directly from a batch file executes concurrently with the batch file. In order to force the batch file to wait until the Windows program terminates, precede the program name with START /W.

Note, too, that you can use the START command to launch documents from within a batch file—START MYLETTER.DOC, for example. Far from eliminating batch files, Windows 95 has given them more power than ever.

You can download all the batch files mentioned in this column from PC Magazine Online (for detailed instructions, see the sidebar "Guide to Our Utilities" in this issue's Utilities column).

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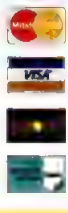
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New RAM for Old



I have seen advertisements for several "SIMM converters." They claim to incorporate four 1MB SIMMs into a holder that will then be recognized as a 4MB SIMM. Do these work? I think this is exactly what I need to make use of my old computer's memory.

WES KAPROV, via ZD Net

PC MAGAZINE: SIMM converters do work; many customers have been satisfied with their ability to combine small-capacity SIMMs into a larger-capacity unit that uses a single SIMM slot. Such devices can also give new life to older 30-pin SIMMs by fitting them into newer 72-pin sockets.

These high-rise constructions, however, may take up space on your motherboard that an expansion card or disk drive wants to occupy. If you use two converters in adjacent slots, you probably need matched left- and right-handed models. Using four adjacent slots will require the use of high and low mod-

els, which will cause even greater obstruction problems.

Of course, other choices are available. The market for used memory has become just as competitive and aggressively priced as the new-memory market. There are several vendors that are willing to buy your old memory outright or give you a sizable credit toward new memory. Some companies advertise memory swaps for \$10 to \$15 per megabyte. One company will even convert four 1MB SIMMs into a 4MB SIMM for \$35 or replace four 1MB units with a new 4MB SIMM for the same price. Since some SIMM converters can cost \$50 or more, trading in your old memory for credit can be cheaper, and you won't have to deal with a high-rise obstacle on your motherboard.—*Alfred Poor*

Push Comes to Shove

After upgrading my system with a VL-Bus motherboard and an AMD 80-MHz 486DX2 CPU, I'm encountering random lockups under Windows. If I slow the system clock down to 33.3 MHz, it runs fine. If I try to get the full 80 MHz out of the CPU, however, the

crashes resume. Can you tell me if there is any way to fix this?

JAMES ALVERN WERTZ,
Republic, Ohio

PC MAGAZINE: Your problem may lie with something other than your CPU. The local bus slots in the VL-Bus specification, for instance, are not rated for speeds faster than 33 MHz unless they are buffered. With your machine, chances are good that the slots are not buffered. There may be one or more local bus cards in these slots that simply can't keep up with the frenetic pace of an 80-MHz clock. The card misses a tick and the system crashes.

To test this hypothesis, remove the local bus cards and see if the problems persist. Temporarily replace a card that fills a critical function, such as a display adapter, with an ISA card of similar function. If the problem then goes away, you may be able to find a better-quality card that can work at the higher speed. Since you're operating above the VESA specification, however, the problem may be at the motherboard level rather than the card level.

The problem could also be a timing error somewhere in system memory. To identify the weak link, systematically eliminate different components in the memory system. Start by disabling the Level 2 cache. Different systems

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INDEX

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CompuLink Research	225
CompUSA	250
Computer City	247
COMPUTER DISCOUNT WAREHOUSE	253
Ergo Computing	270
HARTFORD COMPUTER GROUP	2351
INSIGHT DIRECT, INC.	229
Magitronic	245
MIDWEST COMPUTER WORKS	242
Midwest Micro	268
PCs Compleat	236
USA Flex	263

SOFTWARE/PERIPHERALS/ COMPONENTS

ARLINGTON COMPUTER PRODUCTS	264
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WAREHOUSE	253
First Source International	226
H. Co Memory Upgrades	261
HARTFORD COMPUTER GROUP	2235
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LA Trade	244
Magix	241
MEGAHAUS	258
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MIDWEST COMPUTER WORKS	242
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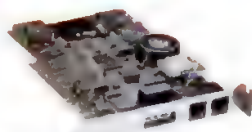


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Get Pentium® processor, get CD-ROM, get 1GB storage and get going!

It's everything you could ask for in a notebook! The Toshiba Tecra 700 includes a fast 120MHz Pentium® processor, a blazing optional 4X CD-ROM drive, and a big 1.13GB removable hard drive. There's even room for more outstanding features like two PC card slots, integrated 16-bit SoundBlaster Pro, stereo speakers, infrared port, true PCI bus...and much, much more! This is truly a full-fledged, bells and whistles, multimedia workhorse packed into a handsome, lightweight portable. Now get going to the phone and order yours from Insight today at our lowest discount price ever!

- 120MHz (2.9v) Pentium® processor
- 11.3" color display
- 8MB RAM(CS); 16MB RAM(CT)
- 1.13GB removable hard drive
- 2 Stacked PC Card slots
- True PCI Bus with PCI/ISA docking
- Integrated 16-bit SoundBlaster Pro compatible audio
- Infrared port
- Lithium Ion Battery
- Optional multimedia PCI desk station with increased expansion capabilities (MATDESKV)
- Stereo speakers
- SelectBay supporting swappable FDD and optional 4X CD-ROM module
- 3 year manufacturer's warranty

The World's
Best Selling
Portables

Tecra 700
\$4,699



Satellite 100CS Notebook

- 75MHz Pentium® processor
- 10.4" SVGA dual scan color
- 8MB RAM/500MB hard drive
- Built-in power supply, no AC Adapter needed
- 2 Type II or 1 Type III PC Card slots
- NiMH Battery
- Weighs only 6.9 pounds
- 1 year manufacturer's warranty



100CS
\$1,949

Toshiba Notebooks

Model	Processor	Screen	RAM/HDD	Prod. Code	Price
Satellite T2130	486DX4/75	10.4" Dual Scan	8MB/500MB	MAT2130CS5	\$1,549
Portege 610CT	Pentium 90	9.5" Active	8MB/686MB	MAT610CT8	3,899
Satellite Pro 400	Pentium 75	10.4" Dual Scan	8MB/772MB	MAT400CS7	2,599
Satellite 100CS	Pentium 75	10.4" Dual Scan	8MB	TA100CS	1,949
Satellite Pro 410	Pentium 90	11.3" Active	8MB/772MB	TA410CDT7*	4,199
Satellite Pro 410	Pentium 90	11.3" Dual Scan	8MB/772MB	TA410CS7	3,419
Tecra 700	Pentium 120	11.3" Dual Scan	8MB/1.13GB	TA700CS	4,699
Tecra 700	Pentium 120	11.3" Active	16MB/1.13GB	TA700CT	5,799

*Satellite Pro 400CDT and 410CDT include a removable 4X CD-ROM drive

TEXAS INSTRUMENTS

Extensa 550 and 560

Now you can get the power of a Pentium® processor for the price of the competition's 486. The TI Extensa 550 and 560 offer you the flexibility to grow. The floppy disk is removable and interchangeable with an extra lithium ion battery for longer battery life, or a CD-ROM module providing multimedia capabilities or access to large data files. The removable hard drive makes it easy to upgrade to larger capacity drives.

Extensa 550 and 560 Features

- 75MHz Pentium® processor
- 10.4" color display
- 8MB RAM expandable to 40MB
- Up to 1.2GB removable hard drive
- Built-in touchpad pointing device
- Integrated 4X CD-ROM (CD & CDT)
- 16-bit stereo sound (CD & CDT)
- Infrared serial port
- PCI bus architecture
- 1 year manufacturer's warranty



75MHz Pentium® processor, 10.4" dual scan color, 8MB 524MB HDD
\$1,969
TEXT550CS



TravelMate 5100 and 5200 Series

- Up to 120MHz Pentium® processor
- Up to 11.3" color display
- 8MB RAM exp. to 40MB
- Up to 1.2GB hard drive
- 2 Type II or 1 Type III PC Card slots
- Can accommodate 2 Lithium Ion batteries for superior battery life



90MHz Pentium® processor, 10.4" active color, 8MB 1.2GB HDD
\$3,399
TEXTP90CT

Texas Instruments Notebook Models

Model	Processor	Screen	RAM/HDD	Product Code	Price
TravelMate 5100	90MHz Pentium®	10.4" Active Matrix Color	8MB/1.2GB	TEXTP90CT	\$3,399
TravelMate 5100	90MHz Pentium®	11.3" Active Matrix Color	8MB/1.2GB	TEXTP90CTC	4,099
TravelMate 5200	120MHz Pentium®	11.3" Active Matrix Color	8MB/1.2GB	TEXT5200C	4,999
Extensa 450	486DX4/75MHz	10.4" Dual Scan Color	4MB/340MB	TEXT450CS	1,455
Extensa 450T	486DX4/75MHz	9.4" Active Matrix Color	4MB/340MB	TEXT450CT	1,899
Extensa 550	75MHz Pentium®	10.4" Dual Scan Color	8MB/524MB	TEXT550CS	1,969
Extensa 560CD*	75MHz Pentium®	10.4" Dual Scan Color	8MB/810MB	TEXT560CD	2,899
Extensa 560CDT*	75MHz Pentium®	10.4" Active Color	8MB/1.2GB	TEXT560CDT	3,699

*Extensa 560CD and 560CDT models include an integrated 4X CD-ROM drive

One Peripheral Supplier!



Removable Storage

Zip Drive

Affordable external personal storage to backup, organize and move data—as fast as your hard drive!

- Expand your hard drive with 100MB cartridges
- Portable—fits in your hand and weighs only 1 pound
- Backup your hard drive—fast and easy, 29ms access time, up to 1MB/second transfer rate
- Comes with a 100MB cartridge
- Available as a SCSI or parallel port interface



Also available in parallel port.



1995 Winner of Best Buy Award for Best Peripheral Supplier in the Direct Channel

Other iomega Products

Description	Prod. Code	Price
420MB internal tape backup	TBIO420INB	\$99
800MB Easy Travan internal tape backup	TBIO800EA	149.95
800MB Easy Travan external tape backup	TBIO800EXT	149.95
3.2GB Travan internal tape backup	TBIO3200TR	299
3.2GB Travan external tape backup	TBIO3200TP	399
ZIP removable HD for Mac or PC SCSI	IOZIPSCSI	199.95
100MB ZIP cartridge	IOZIPCRTPC	19.95
10-pack of ZIP cartridges	IOZIPC10PC	149
ZIP carrying case	IOZIPCASE	29.95
ZIP mini carrying case	IOZIPMINI	14.95
JAZ 1GB external removable HD SCSI	IOJAZEXT	599
JAZ 1GB internal removable HD	IOJAZINT	499
1GB JAZ cartridge	IOJAZIGBC	129
Bernoulli 230MB w/5 cartridges SCSI	BEB1150K	599
230MB Bernoulli cartridge	BEB230CART	99



Monitors



- .25mm dot pitch
- 1280x1024 resolution
- EPA Energy Star
- Non-Interlaced
- MPR-II compliant

DX17T 17" Monitor \$799
CMDX17T

MAG Monitors

Model	Size	Resolution	INT/NI	Dot Pitch	Prod. Code	Price
DX1495	14"	1024 x 768	NI	.28mm	CMDX1495	\$275
DX1595	15"	1280 x 1024	NI	.28mm	CMDX1595	389
DX15T	15"	1280 x 1024	NI	.25mm	CMDX15T	469
DX1795	17"	1280 x 1024	NI	.26mm	CMDX1795	699
DX17T	17"	1280 x 1024	NI	.25mm	CMDX17T	799
MX21F	21"	1600 x 1200	NI	.28mm	CMMX21F	1,669
MXE15F	15"	1280 x 1024	NI	.28mm	CMMXE15F	439
MPX17F	17"	1600 x 1200	NI	.26mm	CMMXP17F	799



Modems

Sportster® Vi 28.8 Internal Modem

Faxmodem with Personal Voice Mail

New Sportster Vi with Personal Voice Mail puts all the convenience of an answering machine, a fax machine and a reliable U.S. Robotics modem in one compact unit—and it's easy to use, right from your home or office PC. In addition, Sportster Vi lets you talk and send data in one call, over an ordinary phone line.



Sportster 14.4 External MBUSRT14E	\$105
Sportster 14.4 Internal MBUSR2075	95
Sportster 28.8/14.4 V.34 External MBUSRSP34E	195
Sportster 28.8/14.4 V.34 Internal MBUSRSP34I	179
Sportster 14.4/14.4 S/R Voice View VI Ext. MBUSRV34E	215
Sportster 14.4/14.4 S/R Voice View VI Int. MBUSRV34I	109
Sportster 28.8/14.4 S/R Voice View VI Int. MBUSRV28I	195
Sportster 28.8/14.4 S/R Voice View DSVI Int. MBUSRV28D	269
Bit Surfer Pro ISDN External MBUSMTPRO	\$369
Bit Surfer TA210 ISDN External MBUSMTECH	269
Bit Surfer ISDN ISA Internal MBUSMISDI	269
Simple Internet 28.8 External MAC MBUSP34E	\$169
Simple Internet 28.8 External MAC MBUSP34EM	189
Simple Internet PNP 28.8 Internal MBUSP34I	155



Printers and Scanners



**HEWLETT®
PACKARD**

Scanners	Opt. Res.	Type	Max. Doc.	Prod. Code	Price
HP ScanJet 4S	300 dpi	Roller Mono	8.5" x 14"	HPSJ4SPC	\$359
HP ScanJet 4C	600 dpi	Flatbed Color	8.5" x 11.7"	HPSJ4C	949
Scanner Accessories				Prod. Code	Price
ADF Sheet Feeder for 4C				HPSJ4CADF	\$479
Transparency Adapter for 3C/4C				HPSJ4IIT	649
Printers	PPM	DPI	Mem Fonts	Prod. Code	Price
HP DeskJet 660C Printer	4	600	512K 14	HPDJ660C	\$389
HP LaserJet 5L-FS Printer	4	600	1MB 26	HPLJ5L	509
HP LaserJet 5P Printer	6	600	2MB 54	HPLJ5P	879
HP LaserJet 5MP Printer	6	600	3MB 35	HPLJ5MP	1,039

DeskJet 850C Printer \$499
HPDJ850C



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Seagate



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- 8ms access
- Fast-SCSI-2 A/V
- 512KB cache
- 7,200rpm

\$1,199

SCSI Hard Drives

SCSI Controllers

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adaptec

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SCSI2-FAST kit AD1480KIT	\$179
SCSI2-FAST CD-ROM kit AD1506KIT	55
SCSI2-FAST AD1522AKIT	149
SCSI2-FAST AD1530PKIT	179
SCSI2-FAST AD1540	199
SCSI2-FAST AD1542CF	229
SCSI2-FAST AD1542KIT	269
SCSI2-FAST AD2825KIT	139
SCSI2-FAST AD2842AKIT	259
SCSI2-FAST AD2940KIT	289
SCSI2-FAST WIDE AD3040WKIT	529

WESTERN DIGITAL



IDE Hard Drives

IDE Controllers

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Model 18 IDE, ISA, 16-bit, BIOS controller, no floppy GSIMODEL18	\$35
Model 21 IDE, ISA, 16-bit, BIOS controller, H/F, tape GSIMODEL21	49
Model 32 IDE, IDE, 16-bit, BIOS controller, H/F, 2S/1P GSIMODEL32	99
Model 4C IDE, ISA, ISA, 16-bit, controller, runs 8 drives GSIMODEL4C	125
VESA IDE controller, 32-bit, single channel extender card GSIMODELV1	69
VESA IDE controller 32-bit GSIMODELV2	119

Capacity**	Access	Form/Height	Interface	Cache	RPM	Model	Bare Kit	16 Bit Kit
Seagate IDE Drives								
631MB	14ms	3.5" 1"H	IDE Fast-ATA	120	3,811	ST3630A	\$179	\$229
1080MB	10.5ms	3.5" .75"H	IDE Fast-ATA	256	5,400	ST51080A	229	279
1270MB	10.5ms	3.5" 1"H	IDE Fast-ATA	256	5,400	ST51270A	259	309
2167MB	10.5ms	3.5" 1.02"H	IDE Fast-ATA-2	256	5,400	ST32140A	399	449
Seagate 2.5" Drives								
810MB	16ms	2.5" 19.15mm	2.5" IDE Fast-ATA-2	120	4,500	ST9816AG	449	N/A
Seagate SCSI Drives								
1080MB	12.5ms	3.5" .75"H	Fast-SCSI-2 A/V	128	5,400	ST51080N	269	369
2147MB	9ms	3.5" 1"H	Fast-SCSI-2 A/V	512	5,411	ST32430N	699	799
4294MB	9ms	3.5" HH	Fast-SCSI-2 A/V	512	5,411	ST15230N	999	1,099
9090MB	11ms	5.25" FH	Fast-SCSI-2 A/V	1,024	5,400	ST410800N	2,129	2,229
Seagate High Performance Barracuda Drives								
2147MB	8ms	3.5" 1"H	Fast-SCSI-2 A/V	512	7,200	ST32550N	759	859
4294MB	8ms	3.5" HH	Fast-SCSI-2 A/V	1,024	7,200	ST15150N	1,199	1,299
Seagate 68 Pin Wide SCSI Drives								
2147MB	8ms	3.5" 1"H	Fast Wide SCSI-2 A/V	1,024	7,200	ST32550W	819	969
4294MB	8ms	3.5" HH	Fast Wide SCSI-2 A/V	1,024	7,200	ST15150W	1,249	1,399

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Capacity**	Access	Form/Height	Interface	Cache	RPM	Model	Bare Kit	16 Bit Kit
Fujitsu SCSI Drives								
2100MB	8.9ms	3.5" HH	Fast Wide SCSI-2 A/V	512	7,200	FJ2915W*	\$659	\$759
4200MB	8.9ms	3.5" HH	Fast Wide SCSI-2 A/V	512	7,200	FJ2934W*	959	1,059
Micropolis SCSI Drives								
2100MB	8.5ms	3.5" 1"H	Fast-SCSI-2	512	7,200	MC4221S	775	875
4300MB	8.5ms	3.5" HH	Fast-SCSI-2	512	7,200	MC3243S	1,045	1,145
9100MB	12ms	5.25" FH	Fast-SCSI-2	512	5,400	MC1991	1,999	2,099
Micropolis 68 Pin Wide Drives								
2100MB	8.5ms	3.5" 1"H	Fast Wide SCSI-2 A/V	512	7,200	MC4221AVW	949	1,099
4300MB	8.5ms	3.5" HH	Fast Wide SCSI-2 A/V	512	7,200	MC3243AVW	1,249	1,399
9100MB	12ms	5.25" FH	Fast Wide SCSI-2 A/V	512	5,400	MC1991AVW	2,229	2,379
Quantum SCSI Drives								
1080MB	12ms	3.5" 1"H	Fast-SCSI-2	128	5,400	QUFB1080S	299	399
2216MB	8.5ms	3.5" 1"H	Fast-SCSI-2	512	5,400	QUVP3221S	699	799
2150MB	8ms	3.5" 1"H	Fast-SCSI-2	1,024	7,200	QUXP3125S	799	899
4300MB	8ms	3.5" HH	Fast-SCSI-2	1,024	7,200	QUXP4300S	1,099	1,199
Conner SCSI Drives								
1080MB	11ms	3.5" 1"H	Fast-SCSI-2	256	5,400	CFP1080S	299	399
2147MB	8.5ms	3.5" 1"H	Fast-SCSI-2	512	5,400	CFP2105S	699	799
2147MB	8.5ms	3.5" 1"H	Fast-SCSI-2	512	7,200	CFP2107S	799	899
4294MB	9ms	3.5" HH	Fast-SCSI-2	512	7,200	CFP4207S	1,079	1,179
IBM SCSI Drives								
540MB	12ms	3.5" 1"H	Fast-SCSI-2	256	4,500	IB06H8558	195	295
1080MB	10.5ms	3.5" 1"H	Fast-SCSI-2	512	5,400	IB06H8891	290	390
2100MB	7.5ms	3.5" 1"H	Fast-SCSI-2	512	7,200	IB94G3054	1,145	1,245
4500MB	8ms	3.5" HH	Fast-SCSI-2	512	7,200	IB94G3196	1,599	1,699
5310MB	8ms	3.5" HH	Fast-SCSI-2	512	5,400	IB94G3787	1,399	1,499
IBM SCSI 68 Pin Wide Drives								
2100MB	7.5ms	3.5" 1"H	Fast Wide SCSI-2	512	7,200	IB94G3055	1,219	1,369
4500MB	8ms	3.5" HH	Fast Wide SCSI-2	512	7,200	IB94G3057	1,699	1,849
5310MB	8ms	3.5" HH	Fast Wide SCSI-2	512	5,400	IB94G3059	1,499	1,649

**Capacities based upon manufacturer's quoted capacity where 1MB = 1,048,756 bytes.

*All 16 bit IDE kits bundled with GSI Model 21.

Capacity**	Access	Form/Height	Interface	Cache	RPM	Model	Bare Kit	16 Bit Kit
Western Digital IDE Drives								
635MB	10ms	3.5" 1"H	Enhanced IDE	64	4,500	WD2635A	\$179	\$229
850MB	10ms	3.5" 1"H	Enhanced IDE	64	4,500	WD2850A	199	249
1080MB	10ms	3.5" 1"H	Enhanced IDE	128	5,200	WD21000A	229	279
1280MB	10ms	3.5" 1"H	Enhanced IDE	128	5,200	WD21200A	249	299
1620MB	10ms	3.5" 1"H	Enhanced IDE	128	5,200	WD31600A	339	389
2100MB	10ms	3.5" 1"H	Enhanced IDE	128	5,200	WD32100A	429	479
2500MB	10ms	3.5" 1"H	Enhanced IDE	128	5,200	WD32500A	469	519

**Capacities based upon manufacturer's quoted capacity where 1MB = 1,048,756 bytes.

*All 16 bit IDE kits bundled with GSI Model 21.

Capacity**	Access	Form/Height	Interface	Cache	RPM	Model	Bare Kit	16 Bit Kit
Fujitsu IDE Drives								
1090MB	12ms	3.5" 1"H	Fast-ATA-2	64	4,500	FJ614A	\$215	\$265
Quantum IDE Drives								
850MB	14ms	3.5" 1"H	Fast-ATA-2	128	4,500	QUTR850A	209	259
1080MB	12ms	3.5" 1"H	Fast-ATA-2	128	5,400	QUFB1080A	235	285
1280MB	12ms	3.5" 1"H	Fast-ATA-2	128	5,400	QUFB1280A	259	309
Maxtor IDE Drives								
1260MB	12ms	3.5" 1"H	Enhanced IDE	256	4,500	MX71260AV	260	310
1620MB	11ms	3.5" 1"H	Enhanced IDE	256	4,500	MX71626A	349	399
Conner IDE Drives								
850MB	14ms	3.5" 1"H	Enhanced IDE	32	3,600	CFS850A	199	249
1275MB	14ms	3.5" 1"H	Enhanced IDE	32	3,600	CFS1275A	259	309
IBM IDE Drives								
540MB	12ms	3.5" 1"H	Fast-ATA-2	256	4,500	IB06H7141	185	205
1080MB	10.5ms	3.5" 1"H	Fast-ATA-2	512	5,400	IB94G3186	269	319

**Capacities based upon manufacturer's quoted capacity where 1MB = 1,048,756 bytes.

*All 16 bit IDE kits bundled with GSI Model 21.

Seagate



Largest IDE drive available!

2.1GB IDE Drive

- 2113MB capacity
- 5.0m/s access
- IDE Fast ATA-2
- 256KB cache
- 5,400rpm

\$399

BT31246A

PCMCIA CARDS



Collet 14.4/14.4 Faxmodem MEMOT14PCM	\$239
Liasyle Cell 14.4/14.4 S/R Faxmodem MEMOT14SL	249
Power Cellular 14.4/14.4 S/R Faxmodem MEMOT14P	139
Liasyle 28.8/14.4 S/R Faxmodem MEMOT14V4P	255
Marquis 28.8/14.4 Ethernet Faxmodem MEMOT14EPO	429



WAV Jammer 16 bit Sound MMAC0016	\$215
Bus Toaster SCSI2 Controller MMAC00203	195
Ethernet BNC MMAC00216	139
14.4/14.4 Faxmodem MMAC00236	229
14.4/14.4 Faxmodem wholestore purch. MMAC00245	119
Sound/SCSI-2 Multimedia Card MMAC00436	425
PCMCIA Ethernet TP MMAC00482	129
28.8/14.4 V.34 Faxmodem MMAC00482	349
PCMCIA Ethernet MMAC00497	219

MONITORS



14" 28dp 1024x768 Ni CMX01486	\$275
15" 28dp 1280x1024 Ni CMX01581	369
15" 28dp 1280x1024 Ni CMX01597	469
17" 28dp 1280x1024 Ni CMX01789	699
17" 28dp 1280x1024 Ni CMX01777	799
21" 28dp 1600x1200 Ni CMX02177	1,569
15" MXE15F 28dp 1280x1024 Ni CMX01597	439
17" MXP17F 28dp 1600x1200 Ni CMX01777	799



14" 28dp 1024x768 Ni CMX01486	\$249
15" 28dp 1280x1024 Ni CMX01581	359
17" 28dp 1280x1024 Ni CMX01789	659
17" 28dp 1600x1200 Ni CMX01777	699
14" Ultra 28dp 1024x768 Ni CMX01486	249
15" Ultra 28dp 1280x1024 Ni CMX01581	349
17" Ultra 28dp 1280x1024 Ni CMX01789	589



20" 31dp 1280x1024 Ni CMX02177	\$1,069
15" 28dp 1280x1024 Ni CMX01581	349
17" Magnascan 28dp 17B CMX00418	679
15" 2015 28dp 1024x768 Ni EPA CMX02015	325
14" 2099 28dp 1024x768 Ni EPA CMX02099	249
17" 4018 28dp 1280x1024 Ni MPRII EPA CMX04018	659



15" 1562CLR 28dp 1024x768 Ni CMCT1562CLR	\$349
14" 1451C 28dp 1024x768 Ni EPA CMCT1451C	279
15" 1555D 28dp 1280x1024 Ni MPRII EPA CMCT1555D	399
17" 1785GME 28dp 1600x1200 Ni MPRII EPA CMCT1785GME	789
20" 2085 28dp 1600x1200 Ni MPRII EPA CMCT2085	1,229

VIDEO CARDS



Edge 3D 2120XL PCI 1MB DRAM 2MB max VCDIEP16R	\$259
Edge 3D 2200XL PCI 2MB DRAM VCDIEP11R	299
Edge 3D 3240XL PCI 4MB VRAM 4MB max VCDIEP22R	349
Edge 3D 3400XL PCI 4MB VRAM VCDIEP22R	399

POWER PROTECTION



Back UPS Pro 280 PNP 280 V/A UPAPC280P	\$155
Back UPS Pro 420 PNP 420 V/A UPAPC420P	239
Back UPS Pro 650 PNP 650 V/A UPAPC650P	299
Back-Ups 200 UPS 200 V/A UPAPC200S	89
Back-Ups 280 UPS 280 V/A UPAPC280S	129
Back-Ups 400 UPS 400 V/A UPAPC400S	149
Back-Ups 450 UPS 450 V/A UPAPC450S	189
Back-Ups 600 UPS 600 V/A UPAPC600S	249
Back UPS Pro 1000 V/A UPAPC1000S	399
Back UPS Pro 1400 V/A UPAPC1400S	529



Power Fortress 1420 1420 V/A UPSPF1420	\$729
Fortress 1020 VA/675W UPS UPSPF1020	536
SP1 600W Patrol UPS UPSP1600	239
SPS 650W Patrol UPS UPSP1650	419
Smart Patrol 280VA/175W UPS UPSP280	99
Smart Fortress 3000 VA UPS UPSP3000	1,729
Smart Patrol 420VA/260W UPS UPSP420	129
Fortress U660W UPSP1600	369

NETWORKING



EtherExpress Pro/10 ISA NWNT8200	\$115
EtherExpress Pro/10 PCI NWNT8485	219
EtherExpress Pro/10 TX PCI NWNT8488	145
NetPort II NWNT2121	145
Express Stackable Hub 100 Base TX NWNT8675	1,669

NETWORKING



Etherlink III ISA TP NWCS0987P	\$95
Etherlink IIIB PC Card Combo NWCS0800M	189
Etherlink IIIB PC Card TP NWCS0807P	155
Etherlink III ISA BNC NWCS0981	109
Etherlink III ISA Combo NWCS098C	121
Etherlink III PCI TP NWCS097P	109
Etherlink III PCI Combo NWCS09C	159
Fast Ethernet 10/100 PCI TP NWCS085TX	225
Linebuilder 100Mbps FMS 12 port TP NWCS280TX	1,949



EtherEZ Network TP Card NWSMC0418T	\$89
EtherEZ Network Combo Card NWSMC0418T	99
EtherEZ Network Coax Card NWSMC0418B	89
EtherPower 10/100 PCI NWSC032	199
EtherPower PC Combo NWSC032T	249
Tigerhub 100 Fast Ethernet NWSMC0318T	2,449
Tigerswitch XE 24 Port Switch NWSMC03124	3,999



PC Card Ethernet Adapter NWXC2108C	\$199
PC Card Ethernet Adapter NWXC287P	149
PC Card Ethernet/Modem Adapter NWXC02108	439
PC Card Ethernet/Modem Adapter NWXC0287P	429

NOTEBOOKS



80MHz Pentium processor	
8MB 800MB 10.4" Dual Scan Color 501741-301	\$2,899
8MB 1.2GB 10.4" Dual Scan Color 501741-401	3,235
8MB 800MB 10.4" Active Color 501743-301	3,845
8MB 1.2GB 10.4" Active Color 501743-401	4,225

In Touch with Tomorrow



120MHz Pentium processor	
16MB 1.3GB 11.5" Active Color TA9002T	\$5,799
90MHz Pentium processor	
8MB 772MB w/4XCD 11.3" Active Color TA10007T	4,599
8MB 865MB 9.5" Active Color MAT10007S	3,899
8MB 772MB 11.3" Dual Scan Color MAT10007S	3,419
486 75MHz	
8MB 500MB 10.4" Dual Scan Color MAT2130C8S	1,979



90MHz Travelmate Pentium processor	
8MB 1.2GB 10.4" Active Color TEXT90CT	\$4,199
120MHz Travelmate Pentium processor	
8MB 1.2GB 10.4" Active Color TEXT920S	4,999
75MHz Extensa Pentium processor	
8MB 524MB w/CD 10.4" Dual Scan Color TEXT960C	2,865
8MB 524MB w/CD 10.4" Active Color TEXT960CT	3,449

TAPE BACKUP



Ditto External 800MB Parallel TB0800EXT	\$149.95
3.2GB Traven External Floppy TB03200T	299
3.2GB Traven External Parallel TB03200P	399
ZIP External 29ms 1MB/sec transfer I0290C	199.95
JAZ 1GB Removable SCSI I0420C	599



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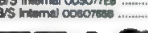
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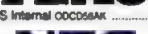
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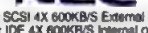
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have different ways to enable and disable the L2 cache. Many use an advanced setting in the CMOS configuration settings. Check your system's configuration-setup features, which are typically on a screen separate from the standard date/time/disk CMOS settings. Some motherboards use a physical jumper to enable or disable the L2 cache instead. If disabling L2 cache eliminates the crashes, reenabling it but adding a wait state (if the BIOS supports such a setting). If the L2 cache isn't the problem, simply add a wait state for your system memory.

Should adding wait states to the cache or system memory solve the problem, you may want to run some benchmark tests to see whether you get better performance at the 33-MHz clock speed with no memory wait states or the 80-MHz speed with wait states. Then you can decide which configuration gives you the best performance. If you want a faster CPU speed but need to stick with the 33-MHz local bus rate, consider replacing your CPU with a clock-tripled chip such as the 486DX4/100; it can run internally at 100 MHz with a system clock speed of 33.3 MHz, which is ideal for VL-Bus.—*Alfred Poor*

Deciphering SIMMs

Do you have any tips on how to read SIMM sizes? How can I tell if I have a 1MB, 4MB, or 8MB SIMM?

LOU AJAMY, via ZD Net

PC MAGAZINE: You can determine a SIMM's size by looking at its individual chips. First, look at the part number for each chip. For 2-, 8- and 9-chip SIMMs, all the chips should have the same part numbers. Look for the number that ends with a dash and a digit, such as "-7". This is the rated speed (-7 indicates a 70-ns rating, for example). Look at the four digits to the left of this number; these often carry information about the number of bits in the chip. A "4256" indicates 256K bits arranged in sets of four, for a total of 1Mb. A "1000" indicates 1Mb of bits arranged in one set.

The tricky part is that sometimes the last one or two digits may be changed to indicate different kinds of memory; there are 1Mb chips that end in 4256, 4257, and 4258. Just round the last digits to an even 256 or thousand. Three-chip SIMMs will typically have two larger chips that are four times the capacity of the third chip (because 4 plus 4 plus 1 makes 9, which is the number of bits needed per byte including parity).

Next, count the chips. If you see three or nine discrete chips, the SIMM probably includes a parity bit for each byte, and you must divide the number of bits by 9 to determine the number of bytes. If there are two or eight chips, the SIMM probably does not include a parity bit. In this case, divide the number of bits by 8 to determine bytes.—*Alfred Poor*

OPERATING ENVIRONMENTS

Taming a Too-Long LOAD= Line



Whenever Windows boots, I get the message "Cannot read 'qui.'" "Qui" seems to be a segment of c:\quick-enw\billmndw.exe from the LOAD= line in my WIN.INI file. Here's my entire LOAD= line:

```
load=c:\utils\pointer.exe c:\plugin
-\plugin.exe winfile.exe c:\winword
-\winword.exe c:\powrpage\ctrlcntr.exe
-c:\3dkbd\3dkbd.exe c:\quickenw
-\billmndw.exe c:\386max\qpopup.exe
-C:\STACKER\sgroup.exe
```

Is the line too long for Windows to read? If so, how do I add a second line?

PIERRE HOURCADE, via ZD Net

PC MAGAZINE: That is surely the longest LOAD= line I have ever seen! And yes, it's too long for Windows to handle. The limit is 127 characters after the equal sign, and if you chop off the line after 127 characters, you'll see that the last item is "c:\qui." Windows attempts to load a program of this name, then complains when it can't be found.

There's no way to add a second LOAD= line. You could almost fit all those programs into the LOAD= line if you moved them into directories with one-character names, for ex-

names that will fit in 127 characters, it permits you to specify command line parameters and to use a working directory that is different from the program's directory.

You can definitely move WINWORD.EXE and WINFILE.EXE to the Startup group. Check the Run Minimized box in the Program Item Properties dialog if you want them to start life minimized. As for the other programs on your LOAD= line, you'll just have to try moving them. Some system-type utilities need to be loaded from the LOAD= line. But even if you don't move anything to Startup except WINWORD.EXE and WINFILE.EXE, you'll have enough space to load the rest as long as you move them to directories with one-character names.

Programs in the Startup group will not load if the user holds down Shift while Program Manager is loading. Any utilities that are absolutely necessary should go on the LOAD= or RUN= line rather than in the Startup group. Also, the LOAD= and RUN= lines are processed before the Startup group. The load order of programs in the Startup group depends on their position in the window. Windows applications load starting with the one in the top left corner, moving left to right across the first row, then the second row, and so on. If DOS applications are also present, they don't load until after all Windows applications have loaded. The DOS applications load in a peculiar order. They run left to right, top to bottom, starting with the second one; the first DOS application is loaded last of all.

—*Neil J. Rubenking*

The Startup group is the best way to load most applications in Windows 3.1.

ample "c:\u\pointer.exe." All but the very last one would fit. You could fit them all on a single line if you moved them into the root directory, but I wouldn't recommend this; you should keep your disk's root directory as empty as possible. You could transfer some of the programs to the RUN= line. But programs loaded with LOAD= start off minimized and run in the background, while those started with RUN= start with their main windows open.

The best solution is to remove as many programs as you can from the LOAD= line and put them into the Startup group in Program Manager. The Startup group is the best way to load most applications in Windows 3.1. Not only is it not limited to the number of program

Internet Access Problems in OS/2

Here are three problems we've encountered trying to access the Internet from OS/2 Warp:

- Nothing happens when we click on the Dial icon for Warp Connect's "Dial other Internet providers" option—the icon just changes to "Hang Up" for a second and then changes right back.

- The alternate Internet providers program won't let us set up a PPP connection.

- After we installed Warp FixPak 10, the Internet dialer stopped working.

Can you help us solve these problems?

JOHN CASSELLI, New York, New York

PC MAGAZINE: The problem of the dialer changing the icon for a second or two only and then stopping without ever trying to dial is usually caused by spaces in the password field. Even though some online services allow blanks in passwords, the dialer won't accept them. If you want to keep the same password, click on Modify Entry to change the settings the dialing program uses for this connection (see Figure 1). Remove any blanks and re-

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Portégé 610CT

- Pentium 90MHz processor
- 9.5" True Color display for optimum color
- Built-in 16-bit sound (SoundBlaster Pro compatible), microphone & speaker
- Lithium Ion battery technology
- Accupoint stick for easy control

Processor	Screen	RAM/HD	Price
Pentium 90MHz	9.5" True Color	8/720MB	\$3999

Tecra 700

- PCI bus architecture (internal & external)
- 11.3" 800x600 high resolution display
- Optional 4X CD-ROM Drive (swap floppy & CD-ROM)
- Multimedia docking station with PCI bus (optional accessory, priced separately)
- Built-in 16-bit sound and microphone
- 2 speakers & MIDI
- HITACHI 1.2GB hard drives

Processor	Screen	RAM/HD	Price
Pentium 120	11.3" Dual Scan	8MB/1.13GB	\$4679
Pentium 120	11.3" Active	16MB/1.13GB	\$4949



120MHz
Pentium
with PCI bus

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Tecra 700

BIG!
11.3"
Screens



Satellite Pro 410

Satellite Pro 410

- Built-in 4X CD-ROM Drive (swap floppy & CD-ROM) (Active model only - optional Dual Scan)
- Built-in 16-bit sound, microphone, speaker & MIDI
- EDO RAM memory exp. to 4MB
- Built-in AC adapter - small, sleek design & reduced weight
- Integrated Accupoint - small, accurate & easy to use
- Lithium Ion battery technology
- Built-in infrared for wireless communications

Processor	Screen	RAM/HD	Price
Pentium 90	11.3" Dual Scan	8/772MB	\$3199
Pentium 90	11.3" Active	8/772MB	\$3999

Satellite 2130CS/100CS

Processor	Screen	RAM/HD	Price
486DX4/75	10.4" Dual Scan	8/500MB	\$1599
Pentium 75	10.4" Dual Scan	8/540MB	1969*

*EDO RAM

Satellite 2130CS/100CS

IBM®



ThinkPad® 365

- 10.4" Active & 10.4" Dual Scan
- Built-in infrared for no-hassle printer connections
- Multimedia models include built-in 2X CD-ROM, SoundBlaster compatible audio, speaker, microphone & MIDI joystick port
- MS Windows 95 or Selecta System models available

Processor	Screen	RAM/HD	Price
486DX4/75	10.4" Dual Scan	8/540MB	\$1999
486DX4/75	10.4" Active	8/540MB	2599
486DX4/75	10.4" Dual Scan	8/540MB	2499*
486DX4/75	10.4" Active	8/540MB	3099*

*Features built-in 2X CD-ROM drive

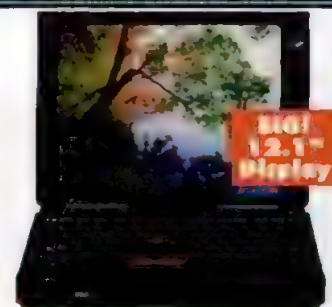
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ThinkPad® 760

- Up to 120MHz Pentium with 32-bit local bus
- 12.1" Active displays with 800x600 resolution (selected models)
- 4X CD-ROM Drive, MPEG-2 support, & full motion video (ThinkPad 600, D only *)
- Built-in 28.8 fax modem
- SoundBlaster compatible audio & telephony
- Lithium Ion battery technology

Processor	Screen	RAM/HD	Price
Pentium 90	10.4" Active	8/720MB	\$4999
Pentium 90	12.1" Active	8/720MB	\$4999
Pentium 120	12.1" Active	8/720MB	\$6999
Pentium 90	12.1" Active	8MB/1.2GB	6699*

*Features built-in 4X CD-ROM drive
WIN 95 models available. Call for details



ThinkPad® 760CD

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600 Notebook PC

HP OmniBook 600

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- Built-in 16-bit sound, microphone & speaker (active model only)
- Built-in infrared for no-hassle printer connections
- Lithium Ion battery technology
- Instant ON - ready-to-work state - lasts for months on a charge

Processor	Screen	RAM/HD	Price
486DX4/75	8.5" Dual Scan	8/340MB	\$2200
486DX4/75	9.5" Active	8/340MB	2500

HP OmniBook 5000

- Up to 120MHz Pentium with 32-bit PCI local bus
- 1.2GB drives available for high capacity storage
- High resolution - 800x600 resolution on notebook display
- Built-in 16-bit sound, microphone & speaker

Processor	Screen	RAM/HD	Price
Pentium 90	10.4" Active	8MB/1.2GB	\$5060
Pentium 90	10.4" Active	16MB/1.2GB	5590
Pentium 120	10.4" Active	16MB/1.2GB	6180

HP OmniBook 5000 Notebook PC



UP TO
120MHz
Pentium
with PCI BUS

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- Built-in 16-bit sound, microphone & speaker
- Integrated touchpad pointer
- 10.4" Active Matrix & 10.4" Dual Scan
- Built-in infrared for wireless communications

Processor	Screen	RAM/HD	Price
Pentium 75	10.4" Dual Scan	810MB	\$2749
Pentium 75	10.4" Active	1.2GB	3699

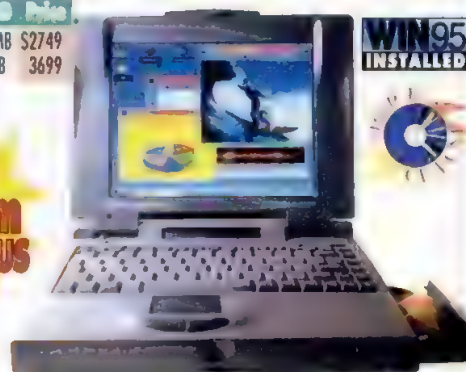
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- Up to 120MHz Pentium with PCI Bus to optimize Pentium processor performance
- 10.4" Active Matrix display with 2MB Video RAM
- High Res. SVGA displays - 800x600 on notebook display - 5130, 5200 & 5270 only
- 65K colors on notebook display
- 16-bit Sound Card, Speaker, Microphone & MIDI
- Upgradable hard drive - easily add more storage
- Built-in infrared for no-hassle printer connections

Processor	Screen	RAM/HD	Price
Pentium 90	10.4" Active	1.2GB	\$3399
Pentium 90	10.4" Active	1.2GB	3699*
Pentium 120	10.4" Active	1.2GB	4649*
Pentium 120	11.3" Active	1.2GB	5079*

*800 x 600 resolution

**75MHz
Pentium
with PCI BUS**



Extensa 560 Product differs slightly from photo

Extensa 550

- Pentium 75MHz w/PCI bus
 - 10.4" Dual Scan
 - 524MB Hard Drive
- Only \$1949**

TravelMate 5000

NEC

Versa 2000

Processor	Screen	RAM/HD	Price
486DX4/75	9.5" Active	4/350MB	\$2099*
486DX4/75	9.5" Active	8/350MB	2399
486DX4/75	9.5" Active	8/540MB	2599

*14.4 fax/modem not built-in



NEC Versa 4000

NEC Versa 4000

- Built-in CD-ROM drive (standard on some models, optional on others)
- Up to 120MHz Pentium processors
- 256KB Level 2 Cache to optimize performance
- 16-bit color Active High resolution Active Matrix displays available - 800x600 res.
- Built-in 16-bit sound, microphone, MIDI and 2 built-in speakers
- Multimedia docking station with substantial video card & speaker array (optional accessories priced separately)

NEW 120MHz Pentium Model!

Processor	Screen	RAM/HD	Price
Pentium 75	10.4" Dual Scan	8/540MB	\$3499
Pentium 75	10.4" Dual Scan	8/540MB	3799*
Pentium 75	10.1" Active	8/540MB	3999
Pentium 90	10.1" Active	8/810MB	4649*
Pentium 90	10.4" High Res.	8/810MB	4799
Pentium 120	10.1" High Res.	8MB, 1.5GB	5499

* Features built-in CD-ROM drive

COMPAQ

LTE 5000 Series

- Up to 120MHz Pentium power w/PCI bus & 256KB cache
- 32-bit PCI Local bus graphics
- 8MB RAM exp. to 2MB
- Built-in 16-bit sound, microphone & 2 speakers
- MultiBay - holds CD-ROM, 2nd HDD, Floppy, or 2nd battery
- Up to 1.35GB hard drives (2.7GB max. capacity)
- Built-in infrared for wireless communications
- Optional MPEG and TV video adapter

Contura 430

Processor	Screen	RAM/HD	Price
486DX4/100	10.4" Dual Scan	8/720MB	\$2369
486DX4/100	10.4" Active	8/720MB	2939

Processor	Screen	RAM/HD	Price
Pentium 75	10.4" Dual Scan	8/510MB	\$3799
Pentium 75	11.3" Dual Scan	8/810MB	4439
Pentium 75	10.4" Active	8/810MB	4729
Pentium 90	10.4" Active	8/810MB	5339
Pentium 90	10.4" Active	8/810MB	5599*
Pentium 120	10.4" Active	8MB/1.35GB	6149

* Features Built-In CD-ROM drive



LTE 5000

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- Built-in MPEG support for full screen, full motion video
- 32-bit PCI IDE controller - fast disk performance
- LOADS of **FREE** software

Processor	RAM/HD	CD-ROM	Price
Pentium 75	8MB/1GB	4X	\$1699
Pentium 100	8MB/1GB	4X	1999
Pentium 100	16MB/1.6GB	4X	2499
Pentium 120	16MB/1.6GB	4X	2699
Pentium 133	16MB/1.6GB	4X	2999

Monitors priced separately

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Advantage Adventure Multimedia (4X or 6X CD-ROM)

- 6X CD-ROM Drive (most models)
- 6X CD-ROM Drive w/ 3-disc CD changer (selected models)
- Advanced Telephony - 28.8 data-fax modem, telephone answering system and speaker phone (differs by model, call for details)
- Integrated 3-D surround sound
- 64-bit PCI local bus graphics
- AST Works II navigation software - featuring SPOT
- Enhanced IDE interface
- AST Lifetime technical support

All New Models!

Processor	RAM/HD	CD-ROM	Price
Pentium 75	8/950MB	4X	\$1670*
Pentium 100	16MB/2GB	6X	2020
Pentium 133	16MB/2GB	6X	2150
Pentium 150	16MB/1.6GB	6X	2370
Pentium 190	16MB/1.2GB	6X	2000
Pentium 33	16MB/1.6GB	6X	2300
Pentium 50	16MB/2.1GB	6X+	2640
Pentium 166	16MB/2.1GB	6A+	2830

*4X CD-ROM, Delta Bundled with 14" SVGA Monitor,
+w/3-disc CD changer, Monitors priced separately

AST Advantage Adventure



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**High-Fidelity
JBL Speakers**

Digital Starion



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Digital Starion

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- Quad Speed CD-ROM Drive
- Up to Pentium 100 "bazing speed"
- PCI local bus - high speed graphics
- 16-bit 3-D surround sound - Surround Sound Pro-compatible, S/W WaveTable, Premium JBL speaker system
- 28.8 Kbps modem and advanced telephony features (differs by model)
- Loads of **FREE** software preinstalled

All New Models!

Processor	RAM/HD	CD-ROM	Price
Pentium 75	8MB/1.2GB	4X	\$1699
Pentium 100	8MB/1.2GB	4X	1949
Pentium 100	16MB/1.6GB	4X	2449
Pentium 120	16MB/1.6GB	4X	2599
Pentium 133	16MB/1.6GB	4X	2769
Pentium 150	16MB/1.6GB	4X	2999
Pentium 166	16MB/1.6GB	4X	3199

Monitors priced separately

IBM



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- Powerful Pentium processors - 75MHz, 90MHz or 100MHz
- Accelerated 64-bit PCI Local bus graphics
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- Multiple chassis sizes to get the expansion you need - slimline desktop or minitower
- Support for up to 4 IDE devices
- 3 year warranty with 90-day housecall - remote problem resolution

Processor	RAM/HD	Std/Day Price
Pentium 75	8/540MB	3/3 \$1622
Pentium 75	8/540MB	5/5 1679
Pentium 90	8/540MB	3/3 1794
Pentium 90	8/540MB	5/5 1852
Pentium 100	16/540MB	3/3 2139
Pentium 100	16/540MB	5/5 2197

Monitors priced separately

IBM PC 300



**WIN95
INSTALLED**



**HEWLETT
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\$289.99**

C2655A



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C3150A	\$879.99
HP LaserJet 5L printer (IBM, 4ppm, 600dpi)	
C3941A	479.00

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HP DeskJet 340 printer (portable) C2655A	\$289.99
HP DeskJet 600 printer C2184A	289.99
HP DeskJet 600C printer C4547A	299.00
HP DeskJet 660C printer C2164A	389.99
HP DeskJet 660Cse printer C4548A	399.00*
HP DeskJet 855C printer C4551A	499.00
HP DeskJet 1600C printer C3540A	1349.99

Home Office Products

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*Includes Family Font Package



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Processor	Screen	RAM/HD	Price
486DX2/50	9.5" Dual Scan	4/340MB	\$2549
486DX2/50	9.5" Active	8/340MB	3079
486DX4/75	9.5" Active	8/340MB	3319
486DX4/75	9.5" Dual Scan	8/528MB	3079
486DX4/75	9.5" Active	8/528MB	3639

HiNote Ultra
Shown with 4X Mobile
Media Module, optional
accessory priced separately



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- Up to 120MHz Pentium for blazing performance
- High-Res. SVGA displays - 800x600 res. on notebook (selected models)
- Built-in 16-bit sound, microphone & speaker
- Lithium-ion battery technology
- Built-in infrared for no-hassle printer connections

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Processor	Screen	RAM/HD	Price
Pentium 75	10.4" Active	8/800MB	\$2849
Pentium 75	10.4" Active	8MB/1.2GB	3229
Pentium 90	10.4" Active (SVGA)	8/800MB	3899
Pentium 90	10.4" Active (SVGA)	8MB/1.2GB	4150
Pentium 120	11.8" Active (SVGA)	8/800MB	4469
Pentium 120	11.8" Active (SVGA)	8MB/1.2GB	4849

Additional models available. Call for details.

Ascentia 950N



Ascentia J Series

- 10.4", SVGA (800x600 res.) on notebook display
- Up to 100MHz Pentium w/PCI bus and 256KB cache
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PC-3020



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- 32-bit VESA Local bus graphics
- Built-in 16-bit SoundBlaster compatible sound, microphone & 2 speakers (PC-3060 only)
- Built-in 14.4-Kbps voice/data/fax modem (PC-3060 only)

Processor	Screen	RAM/HD	Price
5x86 100MHz	10.4" Dual Scan	8/515MB	\$1900
5x86 100MHz	10.4" Dual Scan	8/515MB	2200

* Model PC-3060. Includes built-in sound system & 14.4 voice/data/fax/modem

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4 CD Changer**
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PCMCIA
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Model	Description	Price
XJ1144	14.4/14.4 XJACK	\$125.00
CC3144	14.4/14.4 PCMCIA	125.00
XJ2144	14.4/14.4 XJACK GOLD	135.00
CC4144	14.4/14.4 PCMCIA GOLD	159.99
XJ2288	28.8/14.4 XJACK	299.99
CC3288	28.8/14.4 PCMCIA	299.99
XJ3144	14.4/14.4 XJACK Cellular•Modem	150.99
XJ3288	28.8/14.4 XJACK Cellular•Modem	325.00
EM1144T	14.4/14.4 Ethernet•Modem	349.99
XJEM1144T	14.4 XJACK Ethernet•Modem	349.99
XJEM1144C	14.4 XJACK Ethernet•Modem	369.99
XJEM3288T	28.8/14.4 XJACK Ethernet•Modem	449.99
XJEM3288C	28.8/14.4 XJACK Ethernet•Modem	469.99

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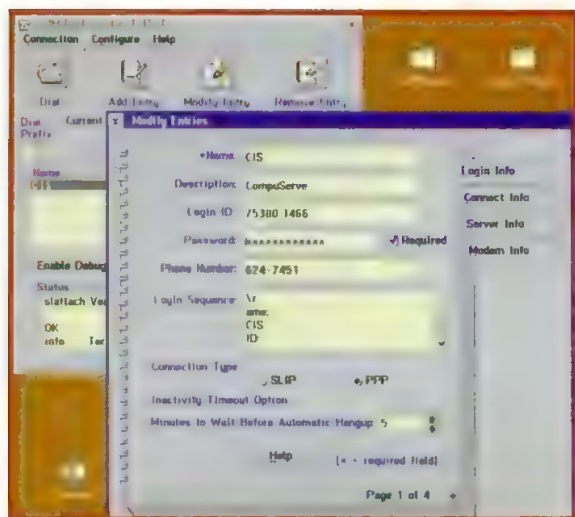


FIGURE 1: Changing the settings of the Internet connection.

place each one with a "s" (without the quotes). This tells the dialer to send a space to the host system.

If this doesn't help, the problem might be the initialization string being sent to your modem. When you open the IBM Internet Connection folder, you see an icon labeled IBM Internet Dialer. This icon loads the dialing program that's used if you connect to the Internet via IBM's Atlantis service. If you use some other Internet provider, you use the dialing program located in the Internet Utilities folder labeled "Dial other Internet providers." These programs don't share any information, including modem initialization commands.

A problem can arise when you update your software via the Retrieve Software Updates option: Warp downloads updates to the modem strings for the IBM Advantix dialer but doesn't update the dialer for other providers. But a Team OS/2 member has created a similarly updated version of the modem command file for the alternate dialer and uploaded it as MODEMIAK.ZIP in the OS2USER forum of CompuServe's Internet Scripts library. This file contains an updated version of the modem.iak file that resides in your \tcip\etc subdirectory.

Updating your software is also the way to go if you're having trouble trying to make a PPP connection—whether you're using Warp or Warp Connect. CompuServe users can download PPP.ZIP from OS2SUPPORT library 20, and Internet users can access <ftp01.ny.us.ibm.net> and download PPP.ZIP from /pub/ppp. But America Online users beware: The version of PPP.ZIP available in the libraries of the OS/2 group is very old. Get the updated PPP.ZIP from the Internet instead.

Download the file into your \tcip subdirectory, and when you extract the archive, make sure you use the parameter that creates or restores the directory structure stored in

the .ZIP file. Info-ZIP's UnZip program does this automatically, but you'll need the -d parameter if you're using PKZIP.

New software is also the answer if your Internet dialer won't work after you install Warp FixPak 10, but in this case the "new" software is an older version of com.sys—the serial port device driver that resides in your \os2\boot directory. The version that comes with FixPak 10 can introduce problems on some systems and so may need to be replaced. If you have FixPak 5, copy its version of com.sys to your system. Otherwise, copy the version from your OS/2 Warp installation disks. Or you can download a working

version of com.sys from the FTP site mentioned above.

And, if you always use the same Internet provider, here's a handy tip that lets you eliminate a step in the connection process. Right-click on the alternate dialer icon and click on Settings from the pop-up menu. In the Parameters field of the settings notebook, enter the name you assigned to your provider (see the Name field in Figure 1). Now when you double-click on the alternate dialer, it will automatically begin dialing your connection service.—Brian Proffitt

Getting Rid of a Bad Icon

Recently, I noticed in Program Manager that both an icon and its program-item label that previously had been fine were now mangled. I have no idea what happened. I tried fixing it in File | Properties, but every attempt to click OK after changing or reentering the Properties information resulted in a GPF crash. I then tried the uninstall program REMOVE-IT, which just gave me the cryptic message, "Unable to delete Program Item." What can I do to solve this pesky problem?

TERRY ZIMMERMAN,
Green Valley, Nevada

PC MAGAZINE: The solution is to create a new Program Group and move the good guys (all but the offending icon) out of the original Program Group and into the new group. Then delete the group that contains the bad icon. You'll want to figure out what program the bad icon was supposed to represent, of course, so you can restore it. This may be easier to do before you move the icons to a new group since the position of the bad icon within the group window may provide some clue.

—Neil J. Rubenking

WORD PROCESSING

Canceling Printing in Word 6 and 7



If you're printing from Microsoft Word 6.x with background printing turned off, Word allows you to cancel the print job by pressing Esc or by clicking on the Cancel button located in a dialog box. If background printing is turned on, there may seem to be no obvious equivalent, but one really does exist: During background printing, an animated printer icon shows up on the status bar at the bottom of the Word screen, along with a count of the number of pages printed. If you want to cancel printing, simply double-click on the printer icon.

CHRIS DENMAN,
Worcester, Massachusetts

PC MAGAZINE: This feature is fully documented in the help files for both Word 6 and Word 7, but it's obscure enough that you're unlikely to find it unless you either know to look for it or happen to trip over it accidentally. And that makes it worth mention here. (To find the reference in Word 6, search for Canceling, then choose the topic Printing a document or can-

Warp downloads updates to the modem strings for the IBM Advantix dialer but doesn't update the dialer for other providers.

celing printing. In Word 7, search for Cancel, then choose the topic Cancel printing.)

If you prefer using the keyboard, there's another option for canceling background printing. If you choose File | Print while Word is printing in the background, you'll get a dialog box that warns you that Word is background printing and that offers you a button to Stop Print. To stop the background printing, just choose the Stop Print button. If you really do want to start printing another document, choose the Print button. Note that this keyboard option doesn't actually cancel anything until you choose the Stop Print button, meaning it takes significantly longer to actually stop printing with this method than by simply double-clicking on the printer icon. Even if you usually prefer using the keyboard for commands, you may want to try the mouse in this case because it's faster.—M. David Stone

SUCCESS



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- 64-bit PCI Graphics Accelerator w/IMB
- 6X EIDE CD ROM Drive/Speakers
- Soundblaster® AWE 32 Soundcard
- U.S. Robotics 28.8VI Voice Fax Modem
- 14" Smile Int'l .28NI Color Monitor
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- Maxiswitch 104 Keyboard
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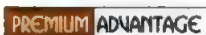
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SPREADSHEETS

Getting User Input in An Excel Macro



I am the membership secretary of an organization, and I use the Lotus 1-2-3 macro (and others like it) shown in Figure 2 to fill out the wording in receipts I mail to members. The macro uses two {?} commands to request input. At the first {?}, I enter the name of the person I'm sending the receipt to. At the second, I enter "and" followed by the name of the person's spouse or, if the recipient is unmarried, I just press Enter. In either case, as soon as I press Enter, the macro simply continues.

I've spent hours trying to re-create this macro in Excel 5.0, to no avail. If I import the macro from 1-2-3 into Excel and use Excel's 1-2-3 macro interpreter to run it, it works fine, but I can't seem to edit the macro or write one like it in Excel. Do I have to keep 1-2-3 on hand just to write these macros and run them in Excel?

GUIDE VENIER,
Sterling Heights, Michigan

PC MAGAZINE: Excel doesn't include an exact equivalent for the 1-2-3 {?} command, but the InputBox function in Visual Basic for Applications (VBA) should serve your needs just as well, if not better. The principal difference between the two commands is that InputBox is designed just to get input from the user. In 1-2-3, however, you can do whatever you want—including move around the worksheet or even quit 1-2-3—while a 1-2-3 macro pauses in response to a {?}. If you don't need that kind of functionality, InputBox should suffice.

Figure 3 shows one way to set up your application macro in VBA. Each time this macro executes an InputBox function, it displays a simple dialog box complete with prompt, default response, and OK and Cancel buttons. When the user clicks OK or Cancel (or presses Enter or Esc), the macro continues, just as 1-2-3 continues when you press Enter after a macro pauses on {?}.

The InputBox function has six arguments, of which all but the first are optional. The syntax looks like this:

```
InputBox(prompt[,title][,default]
[.xpos][.ypos][.helpfile,context])
```

Use the *prompt* argument to tell the user what kind of input you're looking for (for example, the name of the recipient). The *title* and *default* arguments let you insert text for the title bar of the dialog box and a default value for the user's input. In the code fragment in Figure 3, I've repeated the prompt string in the title bar, and I've used the values supplied in the macro's most recent run as defaults for the

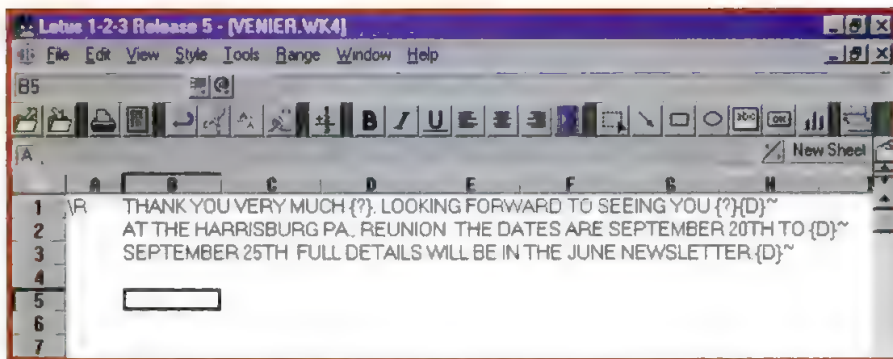


FIGURE 2: The {?} command in 1-2-3 lets a macro stop for user input.

next run. (If this behavior isn't useful, simply delete the first comment line and the line that begins with the word "Static.")

The *xpos* and *ypos* arguments let you specify screen coordinates for the upper-left corner of the dialog box. Chances are you don't need these, however; if you omit them, Excel simply centers the dialog box. Finally, the *helpfile*, *context* argument (it's actually two arguments, but if you include the first you must include the second) gives you a way to furnish your dialog box with help information.

This code fragment assigns the return values of two InputBox functions to variables named RN\$ (for recipient name) and SN\$ (for spouse name). The return values are the characters typed by the user into the dialog box. If the user clicks Cancel or presses Esc, the function returns a null string. The remainder of the macro builds a string based on the contents of RN\$ and SN\$ and makes that string the value of the active cell. Because the input is applied to the current selection, you must have a cell selected when you run the macro. If you run it from a chart sheet or module, you'll get an error message.

If you need to apply the user's input to a particular cell rather than to the current selection, substitute the cell reference for the word Selection. For example, to assign the

string to cell A10 of Sheet 1, you could substitute the following for Selection:

```
Sheets("Sheet 1").Range("A10")
```

I haven't tried to re-create the entirety of your 1-2-3 macro here—just the parts with the variable text. For the unchanging parts of your message, you may as well type directly onto the worksheet. That way your macro won't have to enter the same text on every run.

For a simple macro where all you need to do is change the contents of a text string, the VBA InputBox function is fine. But if you need to control the type of value entered in response to the dialog box, you might want to use the InputBox *method* instead. This looks and works almost exactly like the InputBox function, except you precede it with the word Application followed by a period, like this:

```
Application.InputBox( ... )
```

The InputBox method includes an optional *type* argument that lets you stipulate what kind of data the user is required to enter. If your 1-2-3 macro employs {Getnumber} or {Getlabel}, for example, you'll want to use the InputBox method instead of the InputBox function.—Craig Stinson

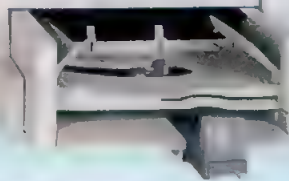
```
Sub Venier()  
    'Keep values of RN$ and SN$ for next run  
    Static RN$, SN$  
    'Display dialogs to get recipient and spouse names  
    RN$ = InputBox("Name of recipient:", "Recipient's Name", RN$)  
    SN$ = InputBox("Name of spouse:", "Spouse's Name", SN$)  
  
    If SN$ <> "" Then  
        Selection.Value = "Thank you very much, " + RN$ _  
            + ". Looking forward to seeing you and " + SN$ + "."  
    Else  
        'Skip the spouse part if the recipient has none  
        Selection.Value = "Thank you very much, " + RN$ _  
            + ". Looking forward to seeing you."  
    End If  
End Sub
```

FIGURE 3: Excel's InputBox function lets a macro take input from a user.



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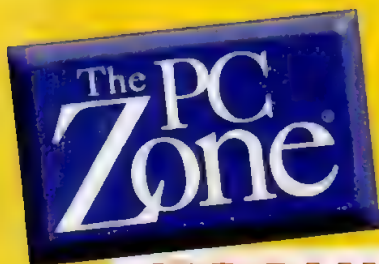
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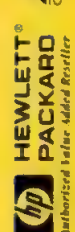
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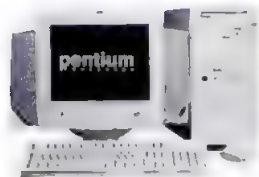
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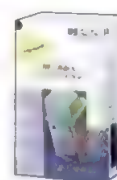
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Determining the Number of Days in a Month



How do you reliably determine the number of days in a month? This is a problem that often stymies people, but the `DaysInMonth` function (shown in Figure 4) does the job in Microsoft FoxPro or Visual FoxPro. Here's how it works.

Let's say you enter a date value in February and you want to know the last date of the month. Given a date parameter such as "2/03/2000," you use the `DAY()` function to subtract the day portion, 3, which leaves you with the last date for the previous month—in this case, "1/31/2000." Then you add 1 to get the first date for the current month, "2/01/95." Next you use the `GOMONTH` function to advance to the next month, leaving you with "03/01/2000." Finally, subtract one day to arrive at the last date for the current month, "2/29/2000," then use the `DAY` function to return only the day number, 29.

STEVE ABRAHAM,
Cape Town, South Africa

PC MAGAZINE: This technique works well, is fast, and takes leap years into account. If you'd rather have a date value representing the last date of the month instead of a numeric value representing the number of days, use the second function in Figure 4, which I've named `EomDate`. For instance,

```
FUNCTION DaysInMonth
PARAMETER dDate
RETURN DAY(GOMONTH(dDate - DAY(dDate) + 1, 1) - 1)

FUNCTION EomDate
PARAMETER dDate
RETURN GOMONTH(dDate - DAY(dDate) + 1, 1) - 1

FUNCTION BomDate
PARAMETER dDate
RETURN dDate - DAY(dDate) + 1
```



FIGURE 4: Use these functions in your Microsoft FoxPro or Visual FoxPro programs when given a date to determine the number of days in a month, to return the last date in a month, or to return the first date in a month.

let's say your user enters the date 2/2/1995 and you need to determine the last date of the month. Pass `Eomdate` the date and it returns 2/28/1995. Pass it 2/2/1996 and it returns 2/29/1996, correctly accounting for the leap year.

The function works in leap years because it relies on FoxPro's ability to perform date arithmetic. Give FoxPro an expression that consists of subtracting 1 from March 1st and it always returns the last date in February. You

can use the third function in Figure 4, `Bomdate`, to quickly return the first date of the month for a given date. It's faster than cutting and pasting "/01/" between the month and the year.—*Sal Ricciardi*

Replacing a Missing Function

Microsoft FoxPro for Windows Version 2.6 has a `Beautify` function available from the Program menu that I've used to indent my source code properly. For some unimaginable reason, Visual FoxPro lacks this feature. Do you know of anything that would work in place of the missing function?

JASON MITCHELL,
New York, New York

PC MAGAZINE: Try Cob Editor Extensions (Cee3) for Visual FoxPro 3.0. Cee3 is an add-on that includes a limited but worthwhile Flow function that will reflow (indent) your code. While it doesn't have `Beautify`'s ability to change the case of keywords and variables, Cee3 does offer a host of other useful enhancements to Visual FoxPro's editor, which is essentially unchanged from previous releases. For example, with Cee3 you can create macros that automatically insert entire program constructs into your code.

This feature, called Keyword Expansion, reminds me of Microsoft Word's Autotext or AutoCorrect capabilities in that it can replace text as you type. For example, you type `DOC` and then press `Alt-Backspace` or just the Spacebar (depending on how you've configured Cee3) to start a `DO CASE` construct. Then you fill in a dialog box that asks for the condition to place on the `CASE` commands and Cee3 automatically inserts the entire construct into your code, including properly indented `DO CASE`, `CASE`, and `END-CASE` statements.

Cee3 comes with macros for all the major constructs as well as a number of useful additions, like one that can insert a nicely documented procedure header with sections for author name, calls, and called by, and another to insert the code required to create a Yes/No/Cancel Message box.

Among Cee3's other niceties are a Function Lister that presents a list of all the functions, procedures, and classes in your code and that also lets you jump to the one you

want to edit, as shown in Figure 5. You can highlight text and change its case or comment/uncomment it, and there's a brace-matching feature that lets you position to a brace, bracket, or parenthesis and find a matching one—useful for deeply nested expressions. There's also a quick way to add the variable at the insertion point to the `LOCAL` or `PRIVATE` declarations list.

Cee3 includes lots of things that FoxPro's editor really, really, really needs, but best of all, it's free. An optional \$129 subscription gets you the source code and additional tools from Cob System Designs. You can down-

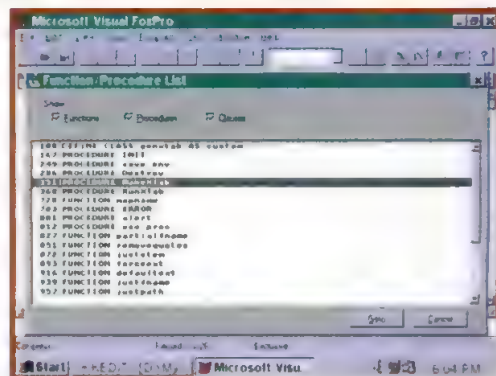


FIGURE 5: Cob Editor Extensions for Visual FoxPro 3.0 includes a useful function/procedure lister that lets you quickly jump to any procedure, function, or class definition in your code.

load Cee3 from the Visual FoxPro Forum on Compuserve, Library 3. Enter `GO CIS:VFOX` and select `CEE30.EXE` in the Helpful Utilities library. You can also contact the authors directly at COB System Designs, 206 South Hampton Drive, Jupiter, FL 33458. Or you can reach them via e-mail at 76557.1106@compuserve.com (Randy Wallin) or 71735.141@compuserve.com (Ryan Katri). —*Sal Ricciardi* □

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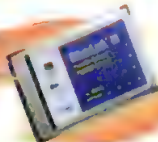
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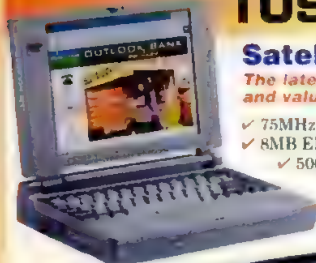
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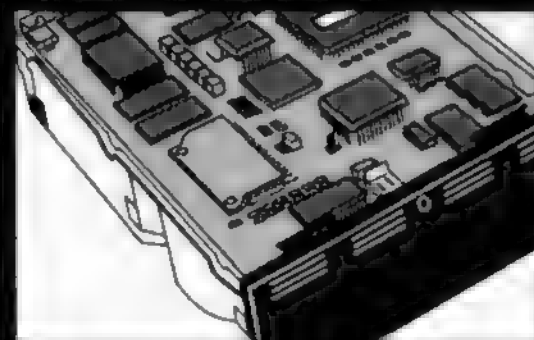
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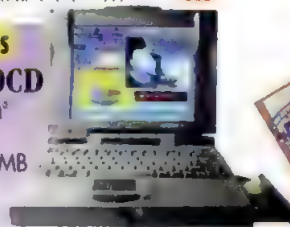
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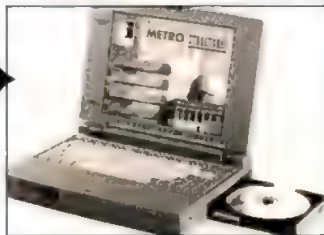
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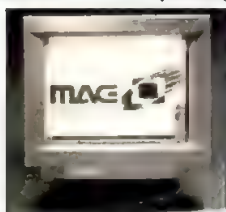
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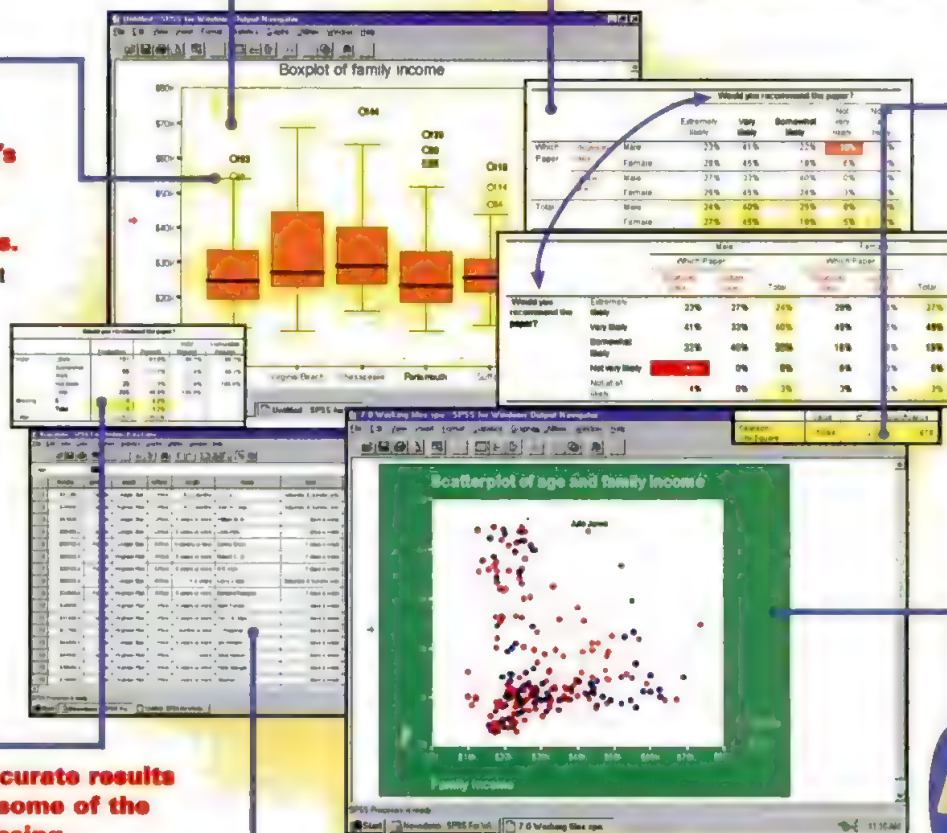
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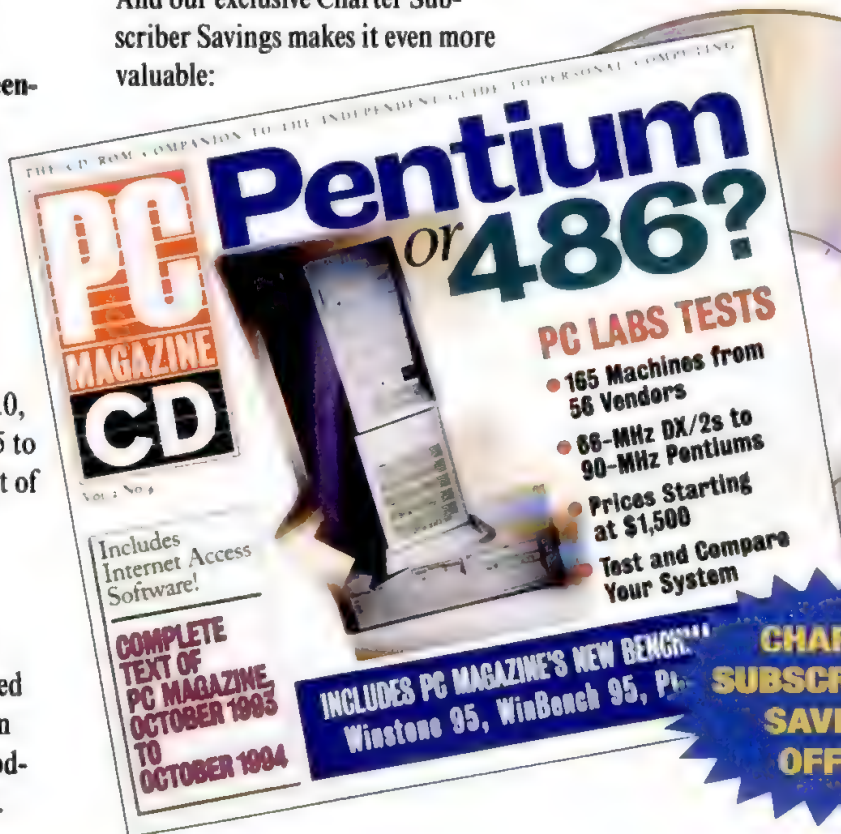
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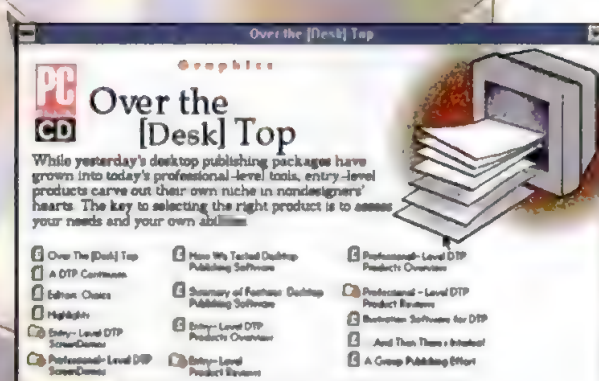
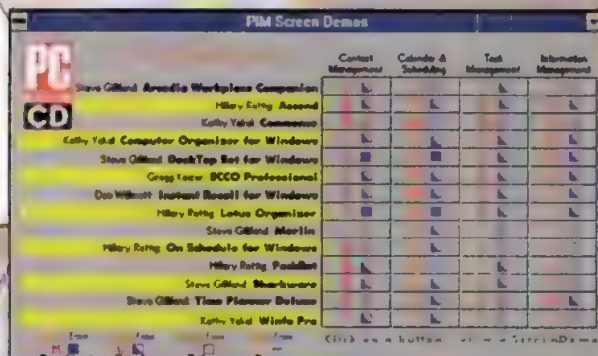
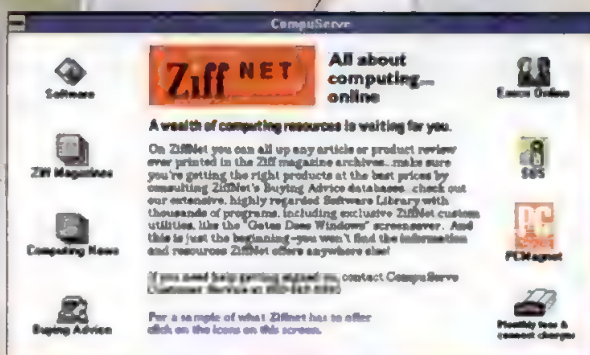
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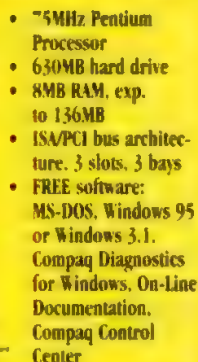
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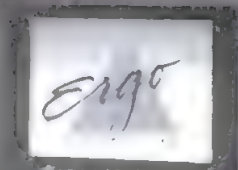
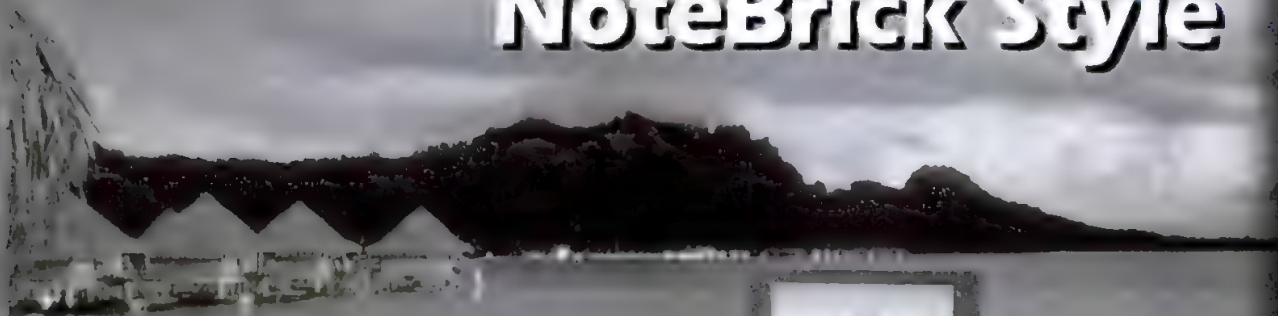
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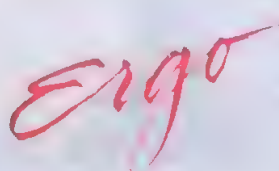
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INDEX

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271-286

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301-302

HARDWARE

	PREMIER	CLASSIFIED
Batteries		
Boards/Components/Chips	272	287
Communications	274	
Computer Systems	275	288
Input/Data Acquisition/Barcode/POS	275,277	289
Mass Storage Devices	281	
Multi-Media	271	
Music/Midi		
Networking	271	291
Peripherals	282	
Power Supplies		
Security		
Video		

SOFTWARE

	PREMIER	CLASSIFIED
Barcode		
Business Applications	283	292
—Single-Solution		
Business Utilities		
CD-ROM Titles	284	292
Cellular Phones		
Communications		292

Data Entry	
Database	
Desktop Publishing	
Education	285, 292
Entertainment/Games	
Financial/Accounting	
Foreign Languages/Font/Translation	292
Graphics/Design/CAD	293
—Digital Output Service	
Health/Fitness/Nutrition	
Human Resource	
Mailing List Management	
Manufacturing/Inventory	
Mapping/Demographic	
Medical/Dental	
Multi-Media	285
Music/Midi	
OS/2	
Personal	
Programming Tools/Languages	
Real Estate	
Religion	

Scientific/Engineering	
Security	293
Shareware/Public Domain	283,286
Statistical/Research	
Utilities	
Windows	286
Adult	298

SERVICES

	PREMIER	CLASSIFIED
Computer Insurance		294
Data Conversion/Data Recovery		294
Desktop Publishing		
On-Line	286	297
Scanning Services		
Software Duplication		295
Training/Tutorial		

MISCELLANEOUS

	PREMIER	CLASSIFIED
Accessories		
Books/Catalogs		
Business Opportunities		
Career Opportunities		
Supplies		297

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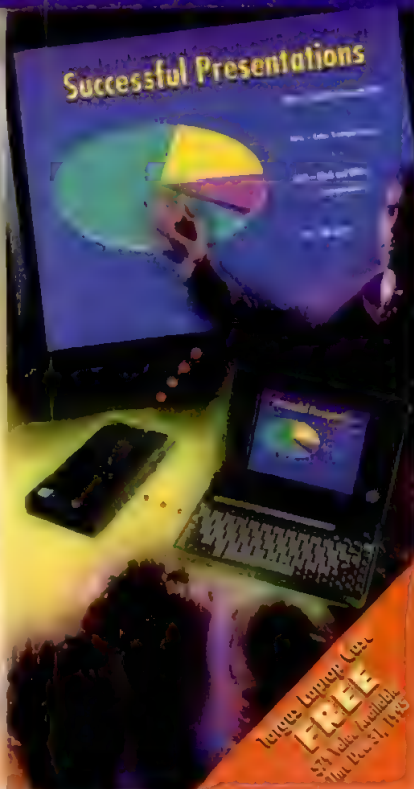
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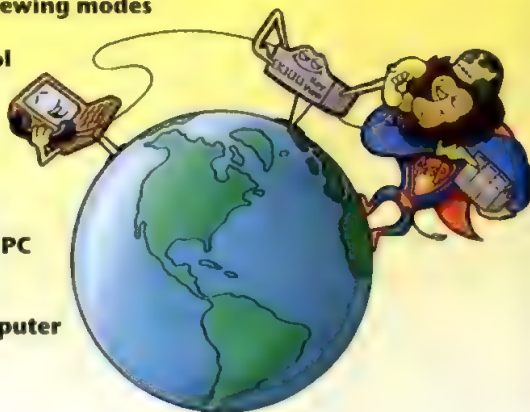
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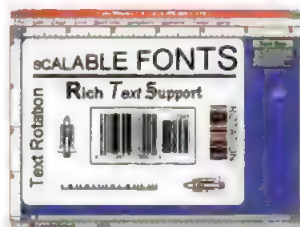
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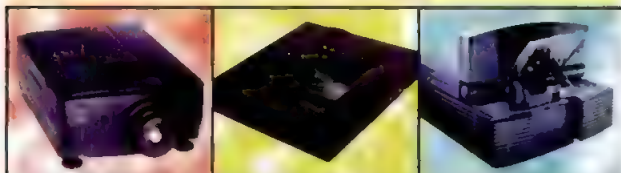
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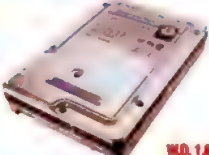
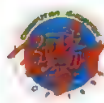
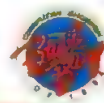
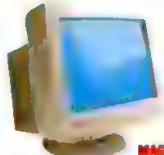
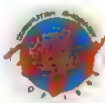
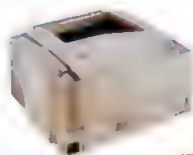
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850MB	10ms	EIDE	64	4,500	\$189
1080MB	10ms	EIDE	128	5,200	\$215
1280MB	10ms	EIDE	64	4,500	\$225
1620MB	10ms	EIDE	128	5,200	\$279

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Capacity	Access	Interface	Cache	RPM	Price
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1080MB	12ms	ATA-2	64	4,500	\$199
1080MB	10ms	SCSI-2	256	5,400	\$285
2100MB	8.9ms	SCSI-2	512	7,200	\$699

Quantum

Capacity	Access	Interface	Cache	RPM	Price
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1080MB	12ms	ATA-2	128	5,400	\$215
1280MB	12ms	ATA-2	128	5,400	\$235
2216MB	8.5ms	SCSI-2	512	5,400	\$669
2150MB	8ms	SCSI-2	1,024	7,200	\$799
4280MB	8.5ms	SCSI-2	512	7,200	\$999

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850MB	12ms	EIDE	64	3,600	\$185
1260MB	12ms	EIDE	256	4,500	\$225
1620MB	11ms	EIDE	256	4,500	\$259

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Capacity	Access	Interface	Cache	RPM	Price
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850MB	14ms	EIDE	32	3,600	\$185
1275MB	14ms	EIDE	32	3,600	\$220
1621MB	14ms	EIDE	32	3,600	\$255
1080MB	11ms	SCSI-2	256	5,400	\$319
2147MB	8.5ms	SCSI-2	512	5,400	\$719
2147MB	8.5ms	SCSI-2	512	7,200	\$749
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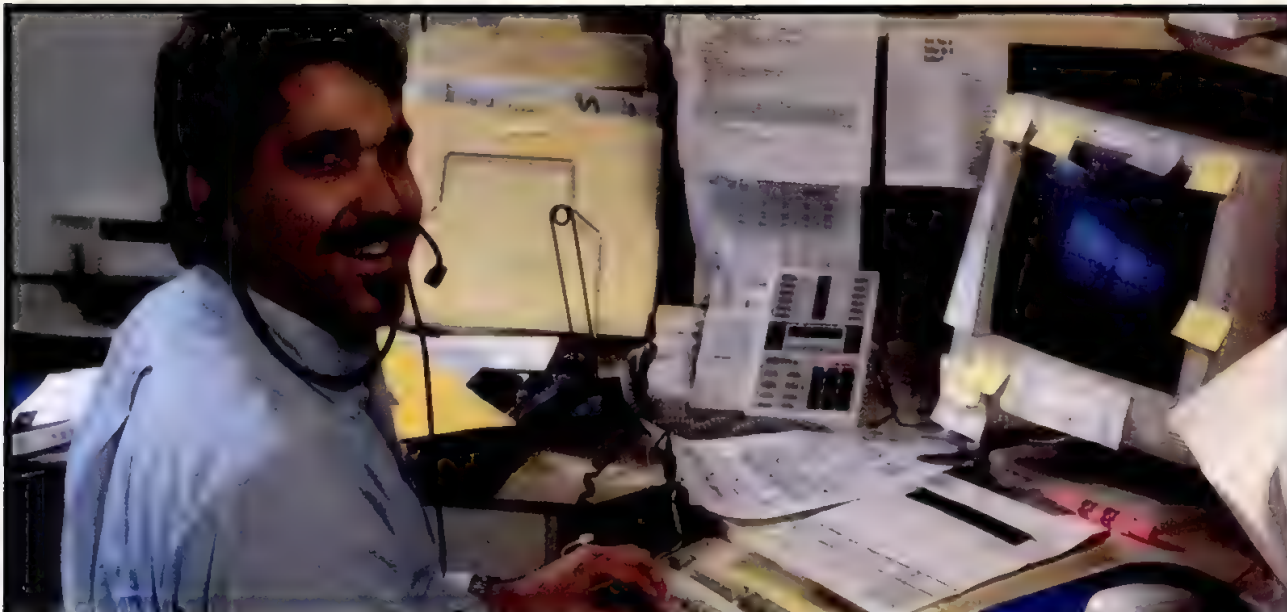
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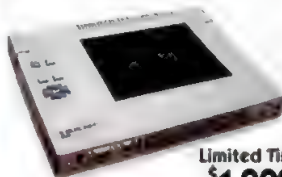


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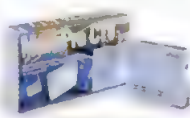
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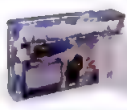
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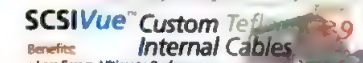


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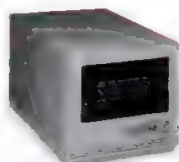
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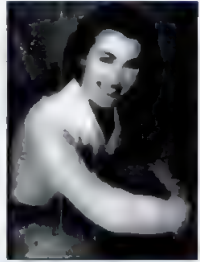
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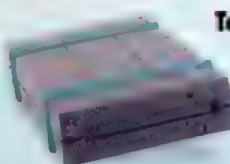
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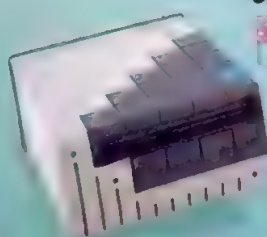
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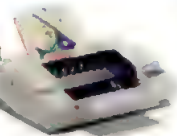
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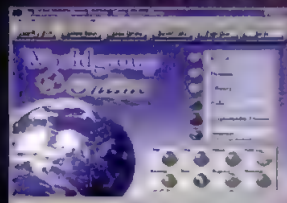
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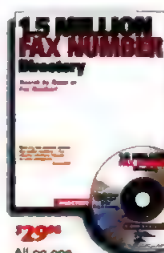


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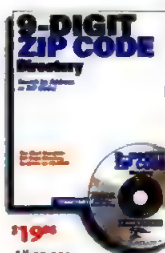


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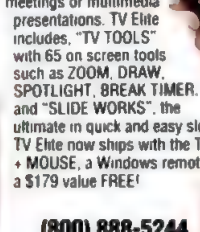
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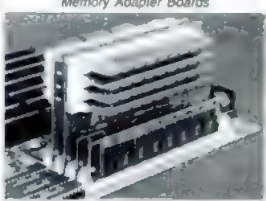
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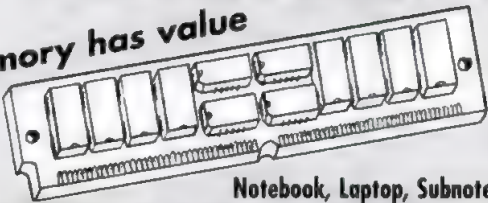
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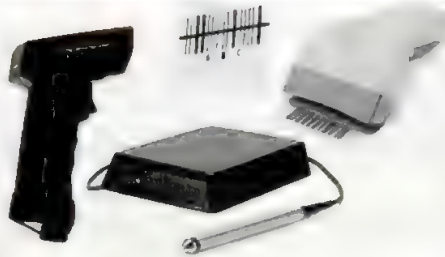
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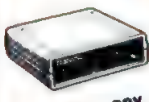
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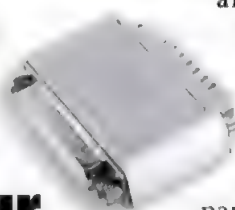
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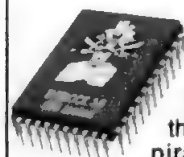
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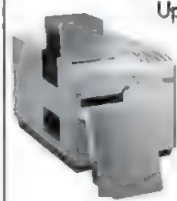
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A SPECIAL REPORT ON PRODUCTS FOR THE PERSONAL SIDE OF COMPUTING



MULTIMEDIA ENCYCLOPEDIAS: Just the Facts?

By Shane Mooney

By now, you've heard it a million times: We're living in the Information Age. What does that mean, you ask? Simply put, never before has it been so easy for so many people to access so much information. One of the best examples of

this is the burgeoning crop of multimedia encyclopedias. These comprehensive reference works serve on a silver platter—literally—an amount of information that once required entire shelves in the local library. With these prod-

ucts, the answers to many of life's questions are no more than a few mouse clicks away.

But what makes a multimedia encyclopedia better than its printed cousin? Besides the obvious fact that they take up considerably less space, these encyclope-

dias provide powerful search engines that help you delve through a wealth of information to find out more about the topic you're looking for. Instead of perusing complex indexes, sorting through a dozen different articles or digging

IN THIS REVIEW

Britannica CD.....	309	Encyclopedia.....	324
Compton's Interactive Encyclopedia, 1996 Edition.....	310	World Book Multimedia Encyclopedia.....	327
Encyclopedia Americana.....	312	The Good, The Bad, and...	308
Microsoft Encarta 96 Encyclopedia.....	318	Editors' Choice	309
1996 Grolier Multimedia		Digging Deeper: History	315
		Digging Deeper: Geography	321

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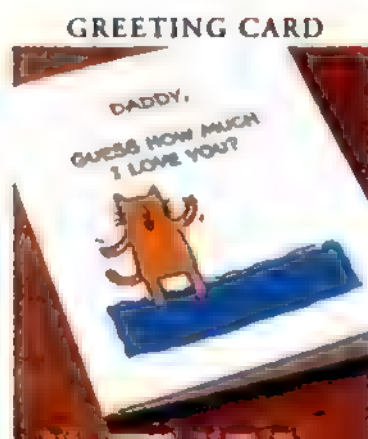
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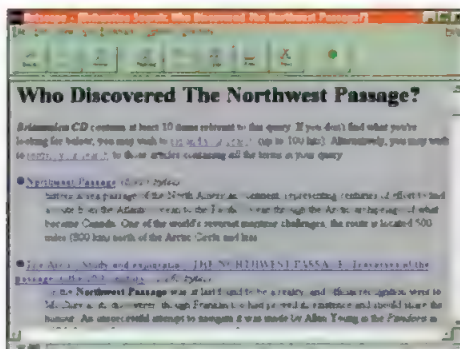
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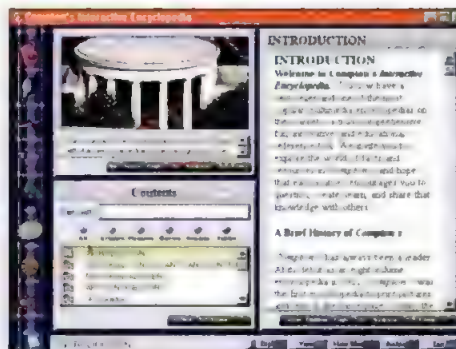
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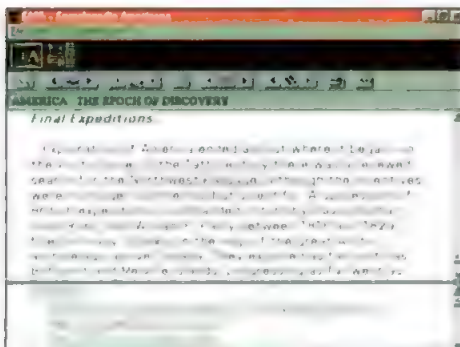
The Good, the Bad, and ...



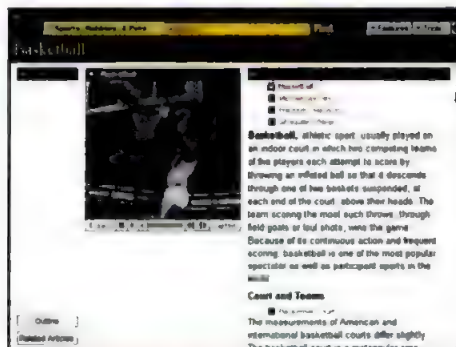
BRITANNICA CD Like Americana, Britannica CD is far from perfect, but we were very impressed with product's search engine. In particular, we liked the scan-ahead feature, which shows the first few lines of each article found in a search.



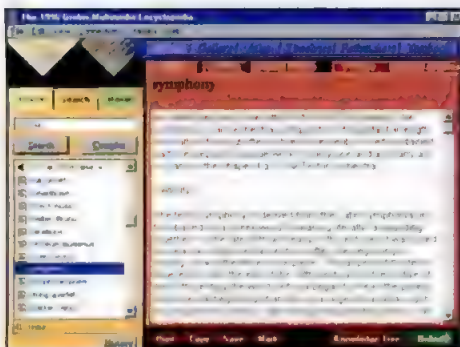
COMPTON'S INTERACTIVE ENCYCLOPEDIA, 1996 EDITION Even though Compton's was the best overall encyclopedia, we did feel that it could use a few improvements. The interface, while easy to use, can seem a bit busy. Hiding a few of the many buttons would help.



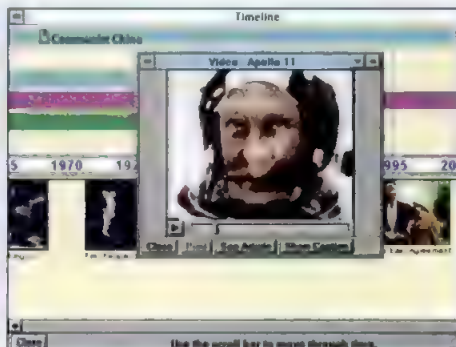
ENCYCLOPEDIA AMERICANA Americana could stand to improve itself in many ways, but the quality of its written content is easily the highest in this review. The articles in Americana were well written and extremely informative, but completely devoid of multimedia.



MICROSOFT ENCARTA 96 Encyclopedia Encarta is impressive in many aspects, but we question the relevance of many of the product's video clips. We would have preferred to see some film of historical importance over this slam dunk any day.



1996 GROLIER MULTIMEDIA ENCYCLOPEDIA In its 1996 edition, Grolier boasts a new, well-designed interface that goes a long way toward narrowing the gap between this product and Compton's and Encarta (the other two members of the Big Three).



WORLD BOOK MULTIMEDIA ENCYCLOPEDIA For a newcomer to the PC stage, World Book certainly impressed us. Combining high-quality, in-depth content with a respectable dose of multimedia, this title is primed to give the other encyclopedias a run for their money.

through a score of tomes scattered across your study just to find out whether or not fish breathe, you can simply type in your question to pull up some articles to answer it. In many cases, you'll also find some relevant pictures, video clips, and audio files that help to illustrate the topic. Instead of just reading about John F. Kennedy, you can see a video clip of him. And instead of seeing a picture of Martin Luther King, Jr., you can see and hear him deliver his famous "I have a dream" speech.

In this story, we review the six major Windows-based multimedia encyclopedias, a group that covers a wide range of price points. At the low end of the spectrum (starting at \$50), we have the Big Three: Compton's Interactive Encyclopedia, Microsoft Encarta 96 Encyclopedia, and 1996 Grolier Multimedia Encyclopedia. At much higher price points, we have Britannica CD and Encyclopedia Americana (\$995 and \$595, respectively). Finally, in a spot that's somewhere in between, we have World Book Multimedia Encyclopedia (\$180). All of the products reviewed here are 1996 editions except for World Book (the 1996 version of World Book did not ship in time for this roundup).

In evaluating these encyclopedias, we focused on five major areas which constitute our Report Card: setup and configuration, informational content, multimedia content, usability, and online resources.

The first of these areas is self-explanatory but just as important to this software category as it is to any other. The informational and multimedia content areas were by far the most important in this roundup. An encyclopedia on

the PC should not only provide a wealth of in-depth—and accurate—information, but it should take advantage of the medium and provide some sort of audiovisual aids not available in a printed book. Of course, both of these areas are useless if the product is not easy to use. Finally, as we do with most software products these days, we took a look at each product's online hooks and resources.

Through all of this, we evaluated the value of each product as it would benefit an entire family of users—not just kids, and not just adults or college-age students.

We think you'll agree: After looking at this group of products, you may never hunt for information the same way again.

Encyclopædia Britannica Inc.

Britannica CD

Encyclopædia Britannica is usually the first thing people think of when you mention the word *encyclopedia*. For years, the leather-bound, gilded pages of Britannica have served as one of the primary learning resources in homes and libraries around the country. Britannica CD, the PC counterpart to the print book, is not quite as dominant in its field. In fact, in a market where any general consumer title approaching the \$1,000 barrier might be expected to ship on several CD-ROMs and feature full-motion video, Britannica CD (which comes on a single CD-ROM) can be a bit of a disappointment. But for those hearty individuals whose thirst for knowledge

far exceeds their desire to see the obligatory video of the Hindenburg crash, Britannica CD will tell you everything you wanted to know through its text.

Setup for this product was something of a chore, mostly because of the included hardware encryption key we had to plug into our PC's parallel port. This key is used to prevent piracy of the encyclopedia. And although the setup process wasn't exactly difficult, it was not nearly as simple as the routines utilized by Compton's or Encarta. The good news here is that Britannica CD comes with a video that explains and shows exactly how to plug the key in and how to get started. Encyclopædia Britannica

Compton's Interactive Encyclopedia, 1996 Edition

These six multimedia encyclopedias each have at least one outstanding quality that sets them apart. When it comes to providing the best overall mix of features, one product stands ahead of the rest—but only by the slimmest of margins.

This year, Compton's Interactive Encyclopedia, 1996 Edition, is our Editors' Choice. With an excellent blend of informational content and features as well as a healthy online presence, Compton's (\$50) is a great informational resource for the entire family. It's well designed, easy to set up, and easy to use. While similar to Encarta in almost every way, Compton's comes across as slightly more refined in most areas and delivers a much more relevant dose of multimedia to complement its textual information.

Microsoft Encarta 96 Encyclopedia (\$55) receives an honorable mention, as it compares favorably with Compton's in most categories. Encarta's one unique feature, an

online update service via The Microsoft Network and the Web, is powerful and could definitely lure potential users away from the other products reviewed here. Combine this feature with a more logical and useful selection of multimedia elements and Encarta could be the best of the bunch.

We also give an honorable mention to World Book Multimedia Encyclopedia (\$180), even though it is a bit rough around the edges. This product combines outstanding and thoroughly detailed content with a generous number of multimedia components. With some refinement and the benefit of experience gained from this initial release, we expect the next edition of World Book will really shake up this market.

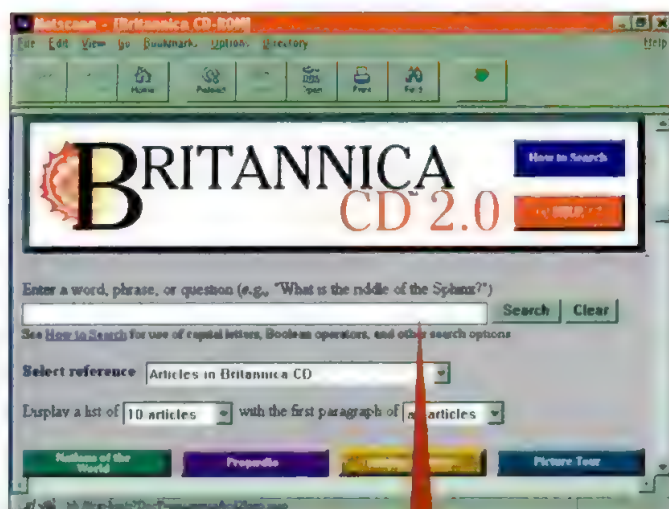


maintains an impressive but expensive online edition on the World Wide Web (\$170 per year to access the full Britannica text online). The CD-ROM version looks and feels exactly like its Web partner—literally. The software for Britannica CD uses a scaled-down version of Netscape Navigator as its interface. This gives Britannica CD a slight edge over Americana in terms of ease of use, but the Big Three stand up as the easiest to use in this review. We found it a bit ironic that this encyclopedia—which, like Americana, is devoid of multimedia content—would choose as its interface a program that so many people use to gain access to multimedia-rich content on the Internet.

The heart of Britannica CD is the search dialog box, which sits at center screen. Here you enter whatever you're looking for, whether it be a word or two or even a question in plain English. We entered the query "Who discovered the Northwest Passage?", and after a quick search, Britannica CD pulled up an article on exploration and even took us right to the appropriate passage in that article.

Like the other encyclopedias, Britannica CD pulls up a list of articles that most closely match your search criteria, listing them in descending order of relevance. But another bonus of the Britannica search engine is the fact that it also shows you the first few

Our Contributors: SHANE MOONEY is a frequent contributor to *PC Magazine*. SARAH L. ROBERTS and TODD SPANGLER are staff editors at *PC Magazine*. MICHAEL E. RYAN was the associate editor in charge of this story.



Britannica CD's interface should be familiar to most users. So should the excellent search engine, which is similar to many of those found on the World Wide Web.

sentences of each article.

Also impressive was the depth of content found in Britannica CD. As with Americana and World Book, Britannica's articles were very thorough and detailed. When

we entered the question "What cities did Cabeza de Vaca discover?", Britannica CD provided an entire article dedicated to the Seven Golden Cities of Cibola. Compton's and Encarta barely even

mentioned these cities in their articles on Cabeza de Vaca.

Unfortunately, Britannica CD had very little information on current events or pop culture. While a 1995 edition of an encyclopedia would not mention such events as the Oklahoma City bombing (April 1995), we expected a 1996 edition to mention it.

And if you're wondering what kind of multimedia \$995 buys, don't bother. While it offers a bit more on this score than Americana, Britannica provides very little in the way of multimedia elements.

If you're looking for a family encyclopedia that everyone will appreciate—including youngsters—Britannica CD should not be your first choice. But it could be, if only the software took better advantage of the platform on which it runs. Adding multimedia content, eliminating the hardware encryption key,

and lowering the exorbitant price would only improve an excellent informational resource for the high-school-and-older crowd.—Shane Mooney

Britannica CD. List price: \$995. Encyclopædia Britannica Inc., Chicago, IL; 800-323-1229, 312-347-7005; <http://www.eb.com>. Circle 453 on reader service card.

SoftKey International Inc.

Compton's Interactive Encyclopedia, 1996 Edition



Even in its printed form, *Compton's Encyclopedia* was always a valuable resource for research.

And why not? It was full of pictures and was well written. And now after evolving over several years in its PC format, Compton's Interactive Encyclopedia, 1996 Edition, strikes an excellent balance of content, multimedia, and usability to provide an ideal encyclopedia for the whole family.

As with Microsoft Encarta, Compton's installation process was smooth as silk, thanks to Autoplay support under Windows 95. Once we got the product loaded, our initial impression of the interface was that it was a bit busy. Every feature, button, and icon was right there on the desktop. This is great if you don't like searching through drop-down boxes for your tools, but not if you prefer aesthetics over convenience.

Things got better in a hurry. For help navigating the interface, we merely had to click on the Explain button to receive guidance from Patrick Stewart (Captain Jean-Luc Picard of "Star Trek: The

REPORT CARDS

Reading the Report Card

A good multimedia encyclopedia for the family can be an invaluable resource for conducting serious research or for simply satisfying personal curiosity. We graded each of these six Windows-based multimedia encyclopedias in five important categories. The grades we used and their meanings are as follows: *A*, excellent; *B*, above average; *C*, average; *D*, below average; *N/A*, not applicable.

An average score for **setup and configuration** indicates that the product was easy to install and required little hard disk space. Higher scores were given for multiple installation options or other helpful features, such as Autoplay support under Windows 95. The highest scores were given only to products that offered all these things plus an uninstall option.

Informational content is the cornerstone of any encyclopedia. Above-average scores indicate not only a wide range of topics covered but also the presence of hypertext links and the availability of multiple articles on most general sub-

jects. High scores reflect articles that are greater in number, more detailed, and, generally speaking, better written.

Average scores for **multimedia content** indicate that at least some pictures or other multimedia elements are used to highlight certain types of articles. Higher scores indicate a greater number of multimedia elements, while the highest scores were given to products that best integrated relevant multimedia elements with written articles.

We also looked closely at each product's overall **usability**. Average scores were given for products that offered features such as an understandable interface and a usable search engine. Higher scores went to those products with more refined features: for example, well-designed interfaces and search engines that were as easy to use as they were powerful.

For **online resources**, high scores went to products that offered a substantial presence or informational updates via online services or the Internet. Those products with no online presence whatsoever were given a rating of *N/A*.

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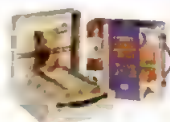
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Alaska	Cactus Flowers	Elephants	Hawaii	Lions	Owls	Soldiers	WW II Planes
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Animals for American Gardens	Canada's East Coast	Exotic Cars	Holland	Meso America	People	Swimming Canada	Yosemite
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Arabian Horses	Canoeing & Kayaking	Fields	Horses	Mexico City	Perennials in Bloom	Thailand	
The Arctic	Caribbean	Flj	Ice & Frost	Military Vehicles	Peru	Tigers	
Arctic Desert	Canes	Finland	Ice & Icebergs	Models	Polar Bears	Trees & Leaves	
Australia	Cheetahs, Leopards & Jaguars	Flowering Potted Plants	Images of Death Valley	Morocco	Portrait of Italy	Tropical Plants	
Austria	China	Flowers	Images of France	Predators	Rajasthan, India	Turkey	
Auto-Racing	China & Tibet	Flowers II	Images of the Grand Canyon	Religious Stained Glass	Rhinos & Hippos	Turkey II	
Autumn	Christmas	Fighter Jets	Images of Thailand	Residential Interiors	Rome	Underwater Life	
Aviation Photography	Churches	Firework Photography	Images of Turkey	Rosettes & Amphibians	Rosae	Underwater Reef	
Backyard Wildlife	Cities of Italy	Fishing	India	Rural Africa	Rural France	Vegetables	
Bald Eagles	Coasts	Food	Indigenous People	Russia, Georgia & Armenia	Sacred Places	Wales	
Bak Indonesia	Coin & Currency	Foxes & Coyotes	Insects	Sailboats	Wild Animals	Waterfall	
Barnyard Animals	Commercial Construction	France	Insects II	San Francisco	Wild Sheep & Goats	Waterfalls	
Barns & Farms	Cougars	Fruits & Vegetables	Ireland	Sand & Solitude	Wildlife Babies	Western Canada	
Beats	Croatia	The Galapagos	Israel				
Beneath the Caribbean	Czech Republic	Germany	Japan				
The Big Apple	Death Valley	Glaciers & Mountains	Japan II				
Birds	Denmark	Grand Canyon	Korea				
Birds II	Deserts	Grapes & Wine					

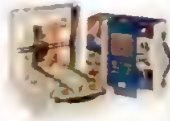
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Air Force	Car Racing	Exploring France	Jamaica	Navy SEALs	Romance of France	Sweden	Yemen
Alps in Spring	Castles	Fabulous Fruit	Japanese Gardens	Nepal	Royal Military Parades	Tail Ships	Zimbabwe
Amateur Sports	Cats & Kittens	Fashion	Jews	Netherlands	Rural England	Teddy Bears	Zion National Park
Antique Postcards	Cavens	Fire Fighting	Jersey Channel Islands	New Guinea	Russia	Textures by James Dawson	
Arthropods	Chicago	Flah	Kenya	New York, New York	Rustic Quebec	Textures II	
Art Textures	Classic Antarctica	Flowers	Kitchens & Bathrooms	Night Scenes	Sailboarding	Theater	
Asian Wildlife	Classic Aviation	Flowers Close-up	Lake District, England	North American People	Sailing	Teddy Bears	
Autumn in Maine	Clouds	Foliage Backgrounds	Landscape Backgrounds	North American Wilderness	Sand & Pebble Textures	Tour Through Europe	
Aviation Photography II	Coast of Norway	Freestyle Skiing	Landscape Backgrounds	Northwest Africa	Scenic Austria	Trans	
Barbecue & Salads	Colorado Plateau	Frost Textures	Landscapes of the World	The Oregon Trail	Scenic Japan	Trains of the World	
Bark Textures	Colors & Textures	Fruit & Nuts	Light Textures	Paris	Scenes	Tropical Sea Life	
Beaches	Colors of Autumn	Fungi	London, England	Paris	Shakespeare's Country	Under the Red Sea	
Beautiful Bali	Construction	Garden Ornaments & Architecture	Lost Civilizations	People II	Sheet Music Cover Girls	Underwater Photography	
Beautiful Women	Copenhagen, Denmark	Gardens of Europe	Lost Tribes	Performance Cars	Shell Textures	Utah, Color Country	
Belgium & Luxembourg	Cowboys	Greek Scenery	Marble Textures	Picturesque Paris	Sierra Nevada Mountains	Valley of Fire	
Berlin	Creative Crystals	Highway & Street Signs	Mariart Arts	Polo	Sights of Africa	Victorian Houses	
Beverages	Creative Textures	Hiking	The Masters I	Portrait of Aeska	Solitude	Virgin Islands	
Bhutan	Gaume	Historic Virginia	The Masters II	Portugal's Countryside	Space	Wading Birds	
Bobbleheads	Decorated Pumpkins	Holiday Sheet Music	The Masters III	Prague	Space Scenes	Washington, D.C.	
Bonnie & Perrying	Devon, England	Holiday Sheet Music	The Masters IV	Prince Edward Island	Spectacular Waterfalls	Washington State	
Botanical Prints	Dog Sledding	Hot Air Balloons	Mediterranean Cruise	Quebec	Speedo Swimmers	Water Sports	
British Motor Collection	Dolphins & Whales	Hunting	Mexican Holiday	Raffa	Spice & Herb Textures	Weddings	
Canada	English Countryside	Images of Egypt	Middle East	Rainy Nights	Sports & Leisure	Whitetail Deer	
Canada, An Aerial View	English Pub Signs	Industry & Transportation	Military Aircraft	Recreational Sports	Spring	Wildcats	
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			Mountains of Eurasia				

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Other individual titles available

Abstract Designs	Beautiful Roses	Coastal Landscapes	Florida	Great Works of Art: Groups & Figures	Histology	Molecules	Patterns in Stone
Abstract Textures	Bobbleheads	Color Backgrounds	Flower Beds	Great Works of Art: Impressions	Historic Battle Re-enactments	Monument Valley	Pedigree Cats
Abstracts & Patterns	Boston	Colors & Textures	Food Objects	Great Works of Art: Landscapes	Historical Monuments	Moths & Butterflies	Pedigree Dogs
African Wildlife	British Columbia	Contemporary Buildings	Food Textures	Great Works of Art: Portraits	Indonesia	Museum China	People at Work
Agates	Canaria Games	Contemporary Buildings	Forests & Trees	Great Works of Art: Studies of the Masters	Industry	Museum Dolls	
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Alien Landscapes	Cards	Eastern Europe	Glamour	Great Works of Art: The Orient	Jewelry	Museum Glass	
Alligators, Crocodiles & Anacondas	Carnier Aviation	EMS Rescue	Great Works of Art: Art of America	Great Works of Art: The Orient	Light Textures	Museum International Toys	
Amphibians	Children of the World	England	Great Works of Art: Art of Antiquity	Great Works of Art: The Orient	Mammals	Museum Toys	
Ancient Architecture	Classic Aircraft Illustrations	Exotic Tropical Flowers	Great Works of Art: Dutch Masters	Great Works of Art: The Orient	Marine Life	Museums of Ottawa Hull	
Ancient Carvings & Designs	Classic Automobiles	Fabulous Flowers	Great Works of Art: Dutch Masters	Great Works of Art: The Orient	Masters III	O Canada	
Animals Close-up	Classic Aviation II	Fashion Show	Great Works of Art: Dutch Masters	Great Works of Art: The Orient	Masters IV	Office Interiors	
Army	Classic Aviation III	Fields & Streams	Great Works of Art: Dutch Masters	Great Works of Art: The Orient	Men of the World	Orchids	
Australia's East Coast	Classic Aviation III	Firearms	Great Works of Art: Dutch Masters	Great Works of Art: The Orient	Merchant Marine	Orchids	
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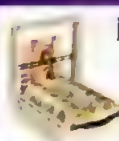
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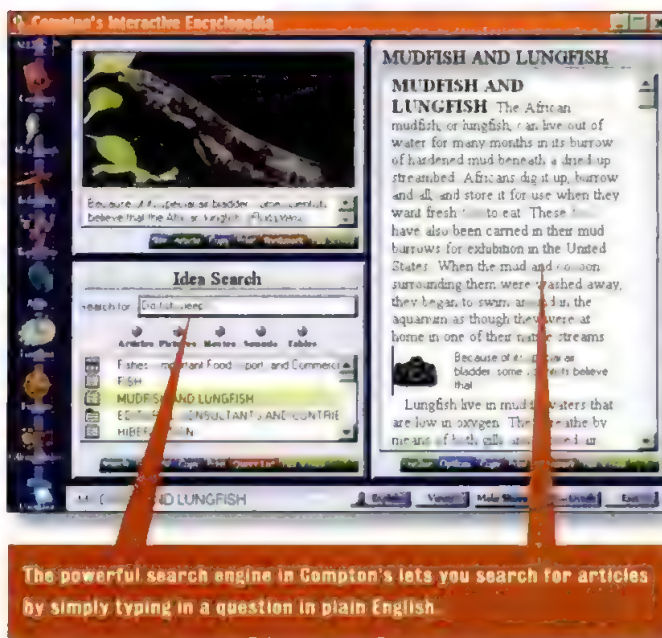
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Next Generation").

Searching Compton's for information on a given topic was easy. The product's search engine allows you to look not only for article headings but for ideas as well. For example, we looked for the name of John Paul Jones's Revolutionary War flagship and found the answer by entering a portion of his famous quote "I have not yet begun to fight." As with Britannica CD, we could even enter search criteria in the form of a question; the search engine pulls the key words out of the query and finds any articles even remotely related to those terms.

Compton's includes approximately 35,000 articles, and although many of these are short, they are similar to those found in Grolier Multimedia Encyclopedia and often provided just as much information as longer ones in Encarta.

Compton's really shines when it comes to multimedia. When we looked up information on artist Georges Braque, for example, the article Compton's gave us included two of his paintings,



whereas Americana, Britannica, and Encarta offered no such visual aids. Compton's also provides a lot of video clips that actually have some historical significance, unlike many of Encarta's. We found clips ranging from President Nixon's resignation to relatively recent events like the World Trade Center bombing. Although the clips played in very small windows, they were useful and informative, much like those we found in World Book Multimedia

Encyclopedia.

Continuing on the multimedia theme, Compton's also includes a multimedia studio that really strengthens the product's family appeal. Here your children can create their own multimedia reports or presentations by pulling from the many pictures, videos, and sound clips on the CD. You can even record your own narration over the presentation. You can play these presentations on any PC (as long as you also have the CD handy).

Kids will also enjoy the six different environments they can explore through Compton's. These environments are

virtual rooms that can be explored by clicking on hot spots relating to certain topics.

In the area of online support, Compton's is a standout: Through a very well-designed section on America Online, you can not only browse the entire text of the encyclopedia (minus the multimedia goodies) but also read articles on recent events and research the Topic of the Month. The only real disadvantage here is the fact that, unlike Encarta, Compton's does not let you download periodic updates for the CD-based product. You have to read them online. And of course, if you already use America Online and you don't care for pictures and video clips, you can enjoy the full text of Compton's without purchasing the CD.

The interface may not be quite as slick as Encarta's, and the content is not quite as deep as Britannica's or World Book's, but the overall mix of quality features Compton's offers makes it the best all-around encyclopedia for the entire family.—SM

Compton's Interactive Encyclopedia, 1996 Edition. Estimated street price: \$50. SoftKey International Inc. Cambridge, MA; 800-227-5609, 617-494-1200; fax, 617-225-0318; <http://www.softkey.com>. Circle 454 on reader service card.

Encyclopedias by Age Group

The heavier color indicates the most appropriate age groups for users of each product. The lighter color indicates ages of users who might also enjoy using each product.

	8	9	10	11	12	13	14	15	16	17	18	19	20	Adult
Britannica CD														
Compton's Interactive Encyclopedia, 1996 Edition														
Encyclopedia Americana														
Microsoft Encarta 96 Encyclopedia														
1996 Grolier Multimedia Encyclopedia														
World Book Multimedia Encyclopedia														

Grolier Interactive

Encyclopedia Americana

Encyclopedia Americana is the best-written, most in-depth encyclopedia we looked at for this roundup. Unfortunately, it falls so short in so many other categories that it really does not compare favorably with any of the other products reviewed here.



You're on your own, but you're not alone.

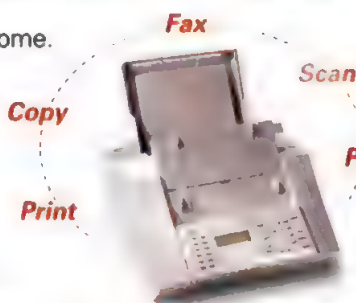
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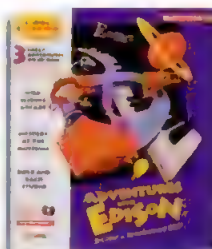
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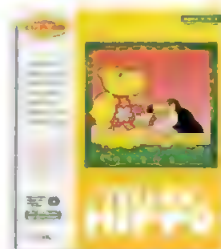
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Digging Deeper: History

By Michael E. Ryan

Encyclopedias are by no means the only reference works available on CD-ROM. The software market is full of informational titles covering a variety of subjects. For this story, we took a quick look at three recently released history CD-ROMs for Windows.

World War II, Global Conflict, from Mentorom Multimedia (\$60, 800-633-9344), is a well-rounded CD-ROM that not only provides detailed accounts of the battles and events of the Second World War but also delineates the course of international events that led into the devastating conflict. The content is presented in a very usable fashion, similar to a series of high school lessons—which seems appropriate, since the CD-ROM is targeted at the junior-high or high-school-level user.

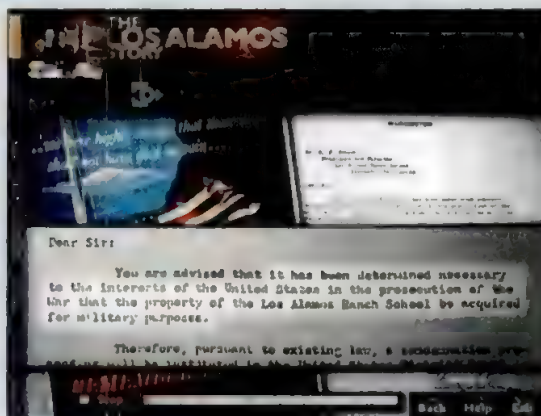
The title contains several documentary-style video clips as well as countless photographs and maps, in addition to written articles. The articles themselves contain numerous hypertext links, most of which are definitions. These links could have been implemented a bit better, however, because many of them contain redundant links, and the definitions often appear as text boxes that run off the screen.

The video clips, on the other hand, are very well presented and informative. As a factual reference on one of the most important events in history, *Global Conflict* is a solid product that deserves a look.

Another product that deserves serious consideration is **Critical Mass** (\$50, Corbis Corp., 800-246-2065). This outstanding title tells the story of America's race to design and build the atomic bomb. In true documentary style, *Critical Mass*

presents a wealth of information behind this chilling effort.

Using the wonderfully designed interface, you can easily jump around to the title's many sections. These include a detailed graphical tour of the Los Alamos site, biographies of J. Robert Oppenheimer and the other scientists involved in the Manhattan Project, several newsreel-like films that help convey the feelings of the period, and multipart documentary segments that tell exactly what went into the building of the first atomic weapons.



Critical Mass makes excellent use of rare documents, footage, and photographs to tell the story of the Manhattan Project.

As you move through this CD-ROM, you may at times lose sight of the fact that you're not watching all this on television. *Critical Mass* boasts some of the best production values we've seen, and it tells a story worth hearing.

Events That Changed the World (\$49.95, ICE, 416-868-6423) also boasts some high production values. This intriguing title provides information on 60 key points in history, ranging from religious, philosophical, and scientific developments to events of military and political significance.

The beautifully-rendered, tab-based interface is designed somewhat like Compton's or Encarta's and makes it easy to pull up information on a particular event. Each event is discussed in text and illustrated with pictures and often portions of historical documents that contain relevant information. Some also include video clips, and others even provide humorous animations that help to keep the mood light (check out the Machiavelli and Sigmund Freud cartoons if you don't believe us).

Even with the light doses of humor, *Events* is a serious title that presents a lot of in-depth information on a variety of important subjects.

To be fair, we found Americana's content extremely informative and well written, providing us with more information on any given topic than we could have hoped for in our searches. One of the reasons for this is that many of the articles were written by experts in their field. For example, we found several articles on naval combat written by a retired naval officer. What

could have been a dry recounting of the facts surrounding John Paul Jones and his battle with the British warship *Serapis* was instead an informative and enthralling read. And with this encyclopedia we were able to find the answers to a few of the questions in our test script that most of the other products could not answer, even including some pop-culture topics such as a

relatively obscure sports query as to the year the Seattle Seahawks entered the National Football League (1976).

Americana's problems begin with the effort one must go through just to find this information. The search engine was the most unwieldy of all the products in this roundup. You are provided with a search box in which you can enter your search criteria. Unlike the sit-

uation with Britannica CD and Compton's, you are forced to use Boolean operators to conduct multiple-term searches. And although there are buttons that make it easy to insert the terms AND, OR, and NOT, the overall search engine seemed needlessly complex when compared with the others in this roundup.

And while a product's interface is not necessarily a make-

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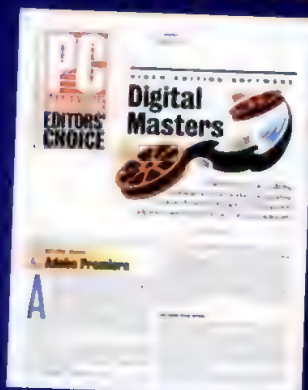
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or-break feature—particularly in this category—Americana's could use a complete overhaul. It looks like little more than a very plain word processor screen (and a word processor stuck on some funky customized font, at that).

The articles in Americana, unlike those in the other products, were broken into single-screen chunks. To view more of an article, you have to click on a hypertext link labeled "More," which brings up another screenful of the story. We didn't see this as a big deal, but compared with simply scrolling through the stories found in the other encyclopedias, it made browsing each article a bit of a chore.

Aside from a few simple sketches, Americana offers no real multimedia to speak of. Even when we checked under flags of a particular country, we got written descriptions of the flags, rather than pictures of them. While the lack of

video and audio is understandable to a point, we found it inexcusable for a product that costs nearly \$600 to be so devoid of illustration; even printed encyclopedias use pictures, maps, and diagrams to illustrate various topics.

Americana also didn't have a lot of the features that the other, lower-priced alternatives contained. For example, there is no atlas, no year-in-review feature, and absolutely no online tie-in. This last feature was sorely missed, as some of the articles seemed to be dated by at least a few years. Like Britannica, Americana suffered from a lack of information on

current events. There was no mention of Rodney King, the 1992 L.A. riots, or the Oklahoma City bombing, for example (although there was a brief mention that O.J. Simpson had been brought up on murder charges).

Even if you find the content in the Big Three encyclo-

pedias thin and money is no object, you'd be better off choosing Britannica CD or—better still—World Book over Encyclopedia Americana. Despite the quality of Americana's articles, the product simply cannot compete with these others as a family encyclopedia.—SM

Encyclopedia Americana. List price: \$595. Grolier Interactive, Danbury, CT; 800-285-4534, 203-797-3530. Circle 455 on reader service card.

Microsoft Corp.

Microsoft Encarta 96 Encyclopedia

When it burst on the scene a few years ago, Microsoft Encarta not only redefined our view of encyclopedias, it redefined our view of multimedia. With each successive year, Microsoft would add a new video clip, tweak the interface, or add some user-friendly interface improvement to keep Encarta ahead of the pack. But this year, Encarta finds itself in a dogfight. In fact, it's not even in the lead, despite the addition of an online update feature that's missing in each of the other products.

Like previous versions of Encarta, the 96 edition installed without a hitch. As you might expect, it offers Autoplay support for Windows 95 users. Also, like Compton's, Encarta offers an uninstall option.

The interface is virtually identical to last year's version, which is a good thing, as it is aesthetically pleasing and intuitive. All the tools you need are cleverly concealed in drop

down menus along the top of the screen. Merely run your cursor over a taskbar command and the box will drop down, revealing a list of tools.

When it came time to look up an article, Encarta's search engine offered several options, including Boolean operators. But the best part was that after we selected an article we wanted, the search box would shrink to an icon and move itself instantly out of our way. We could restore it by merely clicking on it again. This may be a minor thing, but it's the kind of thing that makes Encarta's interface so appealing.

As always, Encarta is spilling over with multimedia content. The video clips play in well-sized boxes and are crisp and clear. The many full-color pictures are brilliant. But one major complaint we have with Encarta's use of video concerns the relevance of the material it presents. Unlike the Compton's, Grolier, and World Book products, Encarta's video often comes across as fluff. With current technology, there isn't a lot of room for all that many videos on these CD-ROMs, so we expect

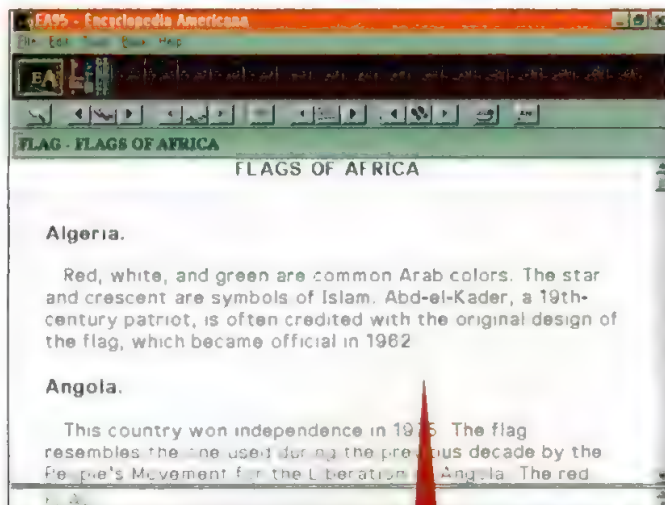
companies to be selective in the videos that are included. Instead of interesting clips of historical figures or events, we more often found pop-culture-oriented clips, like one on basketball and another on dance. In

many cases, these clips seemed like video for video's sake, and this misses the point of a multimedia encyclopedia. Unlike in Grolier and World Book, however, the videos in Encarta are very well integrated with the arti-

REPORT CARD

Encyclopedia Americana

Setup and configuration	B
Informational content	A
Multimedia content	D
Usability	C
Online resources	N/A



Nowhere is Encyclopedia Americana's lack of multimedia more apparent than in these text-only descriptions of the Algerian and Angolan national flags.

REPORT CARD

Microsoft Encarta 96 Encyclopedia

Setup and configuration	A
Informational content	B
Multimedia content	A
Usability	B
Online resources	A

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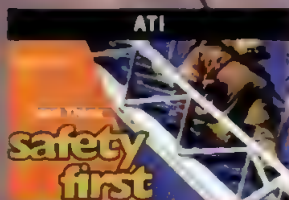
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cles they complement.

As far as informational content goes, Encarta boasts roughly 26,000 articles, which are generally well written and informative. Unfortunately, some seem a little shallow when compared with the pictures and other goodies that Microsoft built into the package. They do not compare favorably with the articles that appear in Americana, Britannica, or World Book, but are similar to those found in

Compton's and Grolier.

One point in Encarta's favor is the inclusion of a good multimedia atlas. Click on a country's map and you can hear the correct pronunciation of the country and the national anthem, and also get some sights and sounds from the country.

The feature that really sets Encarta apart is the new online update feature. Any encyclopedia you buy is destined to go out of date. But

with this edition of Encarta, you can get monthly updates to the product's content. All you have to do is log onto The Microsoft Network or Microsoft's Web site and download the latest update. For example, you can get an update for the article on space exploration that contains information on the recent linkup between the space shuttle *Atlantis* and the *Mir* Space Station. Through a Yearbook feature, you can also get news

highlights for each month, with information listed for just about every day of that month.

Based on informational and multimedia content alone, Encarta slips ever so slightly behind Compton's as the ideal family encyclopedia. But the powerful online features might bring Encarta back into the contest for some users.

—SM

Microsoft Encarta 96 Encyclopedia. Estimated street price:

Digging Deeper: Geography

By Michael E. Ryan

Geography is another one of those topics that many people need to research on regular basis, whether for a trip, for a school project, or just for fun. Since there's no better geographical research tool than a good atlas, we've taken a look at three solid, Windows-based atlases here.

Quick Reference Atlas (\$19, Rand McNally New Media, 800-671-5006, ext. 506) is an affordable and informative atlas CD-ROM that's ideally suited for young users. This title includes hundreds of maps, which can be viewed by boundaries, regions, and other categories. You can view a variety of facts about each country, including its history, economy, and politics.

The interface is relatively basic, but the maps are not. With very few exceptions, the maps in Quick Reference Atlas are richly detailed and colorful, as one might expect from a Rand McNally product (print or otherwise).

One of the more outstanding features in Quick Reference Atlas is the Visual Glossary, which helps teach geographical and geological terms. Simply clicking on a harbor, plateau, or bluff on the color landscape will bring up a definition of that item.

The Visual Glossary, combined with the overall tone and design of Quick Reference Atlas, makes the product an excellent choice for young users (age 10 and up). After all, Quick Reference Atlas is easy to use, easy to understand, informative, and fun.

Packed with even more statistics, **PC Globe Maps 'n' Facts** (\$35, Broderbund, 800-521-6263) is another good atlas, although a slightly buggy one. Through a simple, almost spartan interface, PC Globe lets you browse world maps in

a variety of views, ranging from current (and historical) national boundaries through military and political alliances to literacy rates. The maps are very nicely depicted and well labeled.

PC Globe also lets you peruse a wealth of statistical information on all the countries of the world. For example, you can check worldwide exchange rates, gross national products, and birth rates in different countries and regions.

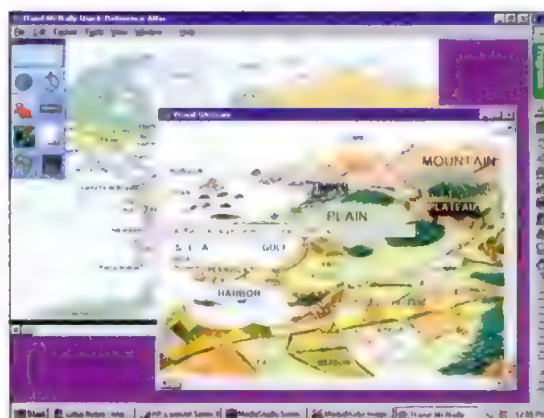
We had a few problems with PC Globe, however. It crashed several times and would not run again until we restarted Windows. Also, when we restarted the program after a crash, the table of exchange rates was blank. Still, PC Globe is a good atlas with an almanac full of additional information.

The most expensive atlas here is also the most visually impressive. **3D Atlas** (\$50, Creative Wonders, 800-543-9778) is a beautifully designed atlas with many multimedia goodies. Most of the audio and video elements in this

title are relevant and informative, so there is some solid content behind the glitz.

3D Atlas starts you off with a space-based view of the Earth, then lets you zoom in and around to view different countries. You can also examine various environmental and geological items and processes, such as continental drift and atmospheric conditions. Finally, 3D Atlas includes some interesting animated flyby sequences that give you a bird's-eye view of the Alps and other mountain ranges.

With a good mix of information and multimedia, 3D Atlas is an intriguing and entertaining geographical reference for users of all ages.

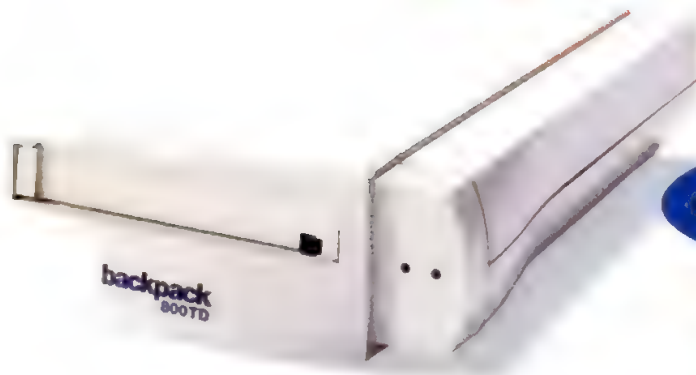


Quick Reference Atlas includes a great Visual Glossary, which is full of geographical and geological terms.



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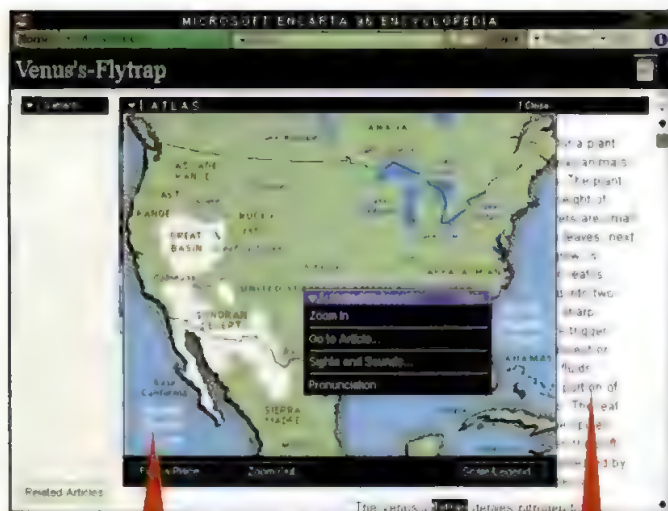
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The pictures, sounds, video clips, and maps are very well integrated with the written text in Encarta, so you never have to look far for illustrations or more information.

\$55. Microsoft Corp., 800-426-9400, 206-882-8080; <http://www.microsoft.com>. Circle 456 on reader service card.

Grolier Interactive

1996 Grolier Multimedia Encyclopedia

Although previous versions suffered from an awkward interface and ran a clear, consistent third to Compton's and Encarta, Grolier Multimedia Encyclopedia has grown into a vibrant, flexible tool. This year's edition is easier to use and includes online links to CompuServe. But even with these features, the

tion of installing WinCIM 1.4 for CompuServe access.

Grolier includes about 34,000 articles, many of which are rather brief. Still, the product's content is solid and provides ample bibliographic references. It's also fairly up to date, with information on many recent events.

Moving through the articles is easy thanks to Grolier's new interface, which is similar to the ones used by Compton's and Encarta. The screen is divided into two panels. On the left, you enter search terms, browse topics, or access previously saved bookmarks. The main panel to the right displays article text. Tabbed folders along the top show any re-

lated pictures, sounds, video, maps, or tables. Longer articles also provide outlines, which help you locate information quickly.

This edition includes an improved search feature that lets you limit a search to

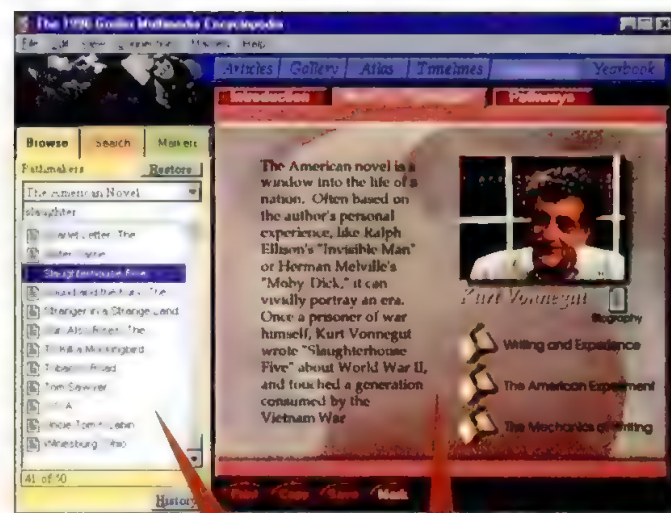
specific subjects or media types. As in previous versions, you can use Boolean and wild-card searches. The new History button tracks a list of items you've referenced. Also, clicking the Knowledge Tree button shows you the location of an article in a hierarchical subject outline. For example, "Jethro Tull" appears under "rock musicians and singers," which is under "rock and pop music," and so on.

Within an article, hyper-text links jump you to other articles on related subjects. Using the toolbar along the bottom of the main panel, you can also save the article to disk, print it, or copy text. One complaint we had here was that you cannot search the text within an article. A search on the term "paradise lost," for example, returned a number of articles on a variety of topics. But we could not easily

video and audio clips are easy to browse in the product's Gallery section, however, these clips are not as well integrated into individual articles as those in Compton's and Encarta.

On the other hand, video and sound are showcased quite nicely in Grolier's special sections. The Timeline, for example, summarizes the span of human history over the course of 11 eras, each of which is recounted through a 1-minute video essay. The Pathmakers section catalogs notable achievers in six categories. And the Yearbook provides images, along with detailed descriptions, of the events of January 1994 through June 1995.

Grolier's online resources are fairly impressive. The product's full text is available on CompuServe, and about one-third of the articles include links to related forums



Grolier now offers a new interface and many new features such as the Pathmakers section, which provides information on important American novels and other topics.

locate the original search term in any of them.

Grolier packs in a respectable amount of multimedia content. Many of the articles are accompanied by at least a single image. While the

and services on CompuServe. CompuServe subscribers simply click on the Online arrow in a story to jump directly to various online areas.

No longer a distant third in the Big Three race, Grolier is a

REPORT CARD

1996 Grolier Multimedia Encyclopedia

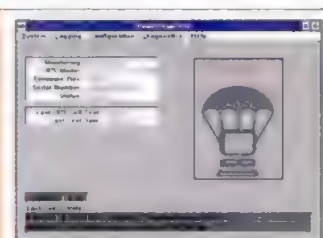
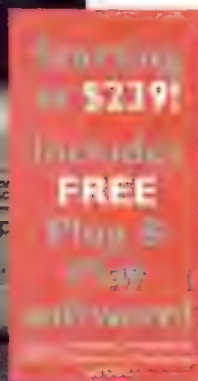
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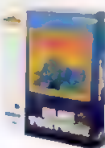
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Multimedia Encyclopedias

well-rounded encyclopedia for the family. It still trails Compton's and Encarta by a half step in most categories, but with the improved interface and new features, the product is a much stronger competitor. —Todd Spangler

1996 Grolier Multimedia Encyclopedia. Estimated street price: \$50. Grolier Interactive, Danbury, CT; 800-285-4534, 203-797-3530; <http://www.grolier.com>. Circle 455 on reader service card.

World Book Inc.

World Book Multimedia Encyclopedia

The familiar encyclopedia set that has helped so many burgeoning scholars through report after report has finally entered the multi-

media arena. The inaugural edition of World Book Multimedia Encyclopedia, which was released in the spring of 1995, is a fine premiere (the 1996 edition was not yet released at the time of this review). The quality of information within the product is stellar, articles are written well, and searches produce useful and relevant results.

Installation and setup were fairly easy, although we ran into one problem. Though the product gives you the option of installing Video for Windows 1.1 (VFW), that particular piece of software was not included on the CD-ROM. Upon installation, a program group for VFW was created, but nothing was in it.

Once you get rolling, however, you'll find that World Book Multimedia Encyclopedia has impressive research



You might have to search a bit for the video clips in World Book, but when you find them you won't be disappointed, as they depict several key events in history.

capabilities. The search tools are easy to use and effective. You can search by general topic or by keywords.

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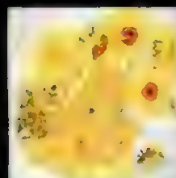


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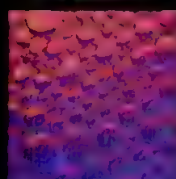
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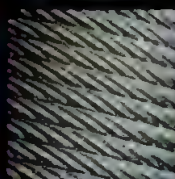
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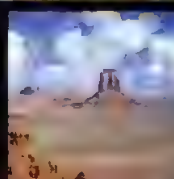
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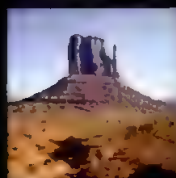
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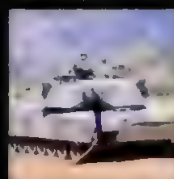
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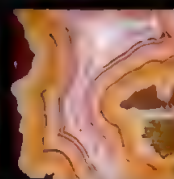
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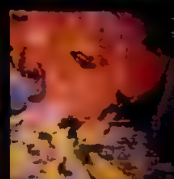
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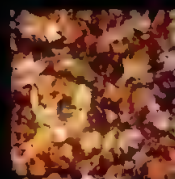
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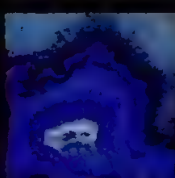
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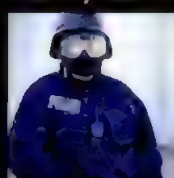
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Multimedia Encyclopedias

expect from World Book: well written and jammed with facts. Many are quite brief but supply you with the essential nuggets of information. And the lengthier articles truly take advantage of the embedded multimedia. For example, the article on baseball includes 11 picture files, most of which are action shots of the game's greats, such as Hank Aaron, Babe Ruth, and Satchel Page. Articles on countries each provide a map of the country and a picture of the country's flag, as well as pictures of various city scenes, cultural events, and landscapes.

Though World Book offers few video clips, those that are included are of prime historical relevance. For example, there are video clips of Martin Luther King, Jr.'s "I have a dream" speech, the Apollo 11 mission, news footage from

the end of the Vietnam War, and so forth. The sound files include excerpts of famous classical compositions, animal sounds, and musical samples of different instruments.

One of the biggest disappointments was the fact that the multimedia components of many articles (with the exception of pictures, which are abundant) are not always easy to find. Unlike Compton's and Encarta, World Book makes you dig a little to find some of the included audio and video files.

Another general complaint was that although search keywords are highlighted, hyperlinks to other articles are not. Obviously, this makes it difficult to determine which words

will allow you to jump to related pieces; you actually have to run the mouse pointer over a given article and watch for it to change from an arrow to a pointing finger.

This product is truly handy for writing reports and conducting structured research, making it perfect for young scholars in the family. Along with its search capabilities, World Book lets you bookmark articles so you can quickly return to them. It also includes a notepad feature. This allows you to take notes as you're reading.

Information on the CD-ROM appears to be current through the end of 1994. Like Americana, World Book has no online component, but up-

date CD-ROMs (\$79) will be available via mailings.

Still, for a first attempt at a multimedia version of its venerable print encyclopedia, World Book has done quite well. Though the implementation is still a bit crude in spots, World Book isn't far behind its competitors. Also, World Book proves that a "serious" encyclopedia can include pictures, video, and sound files without distracting or detracting from the quality of the informational content. With some overall tweaking plus the addition of an online component, World Book could easily leapfrog to the head of this entire product category. —Sarah L. Roberts □

World Book Multimedia Encyclopedia. List price: \$179. World Book Inc., Chicago, IL; 800-621-8202, 708-290-5300; fax, 800-621-9999. Circle 457 on reader service card.

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World Book Multimedia Encyclopedia

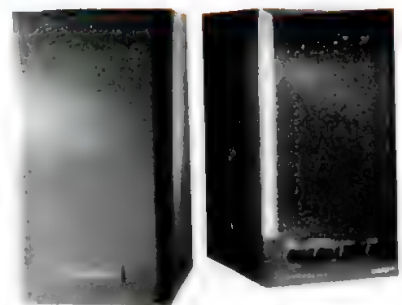
Setup and configuration	B
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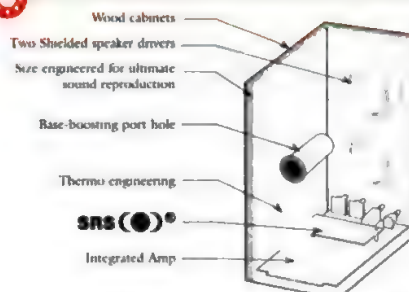
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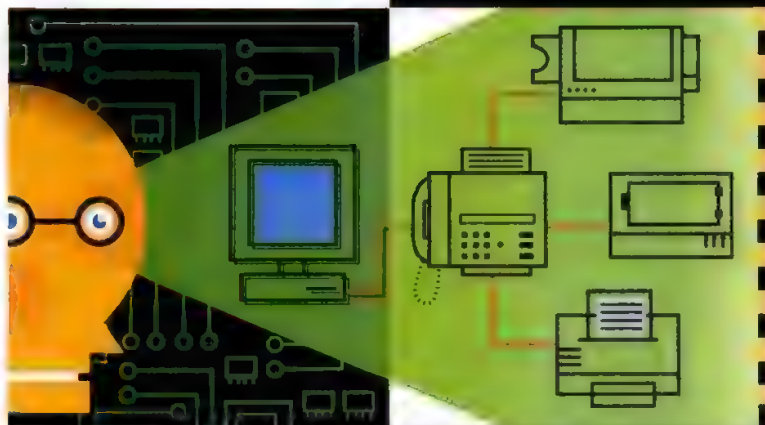


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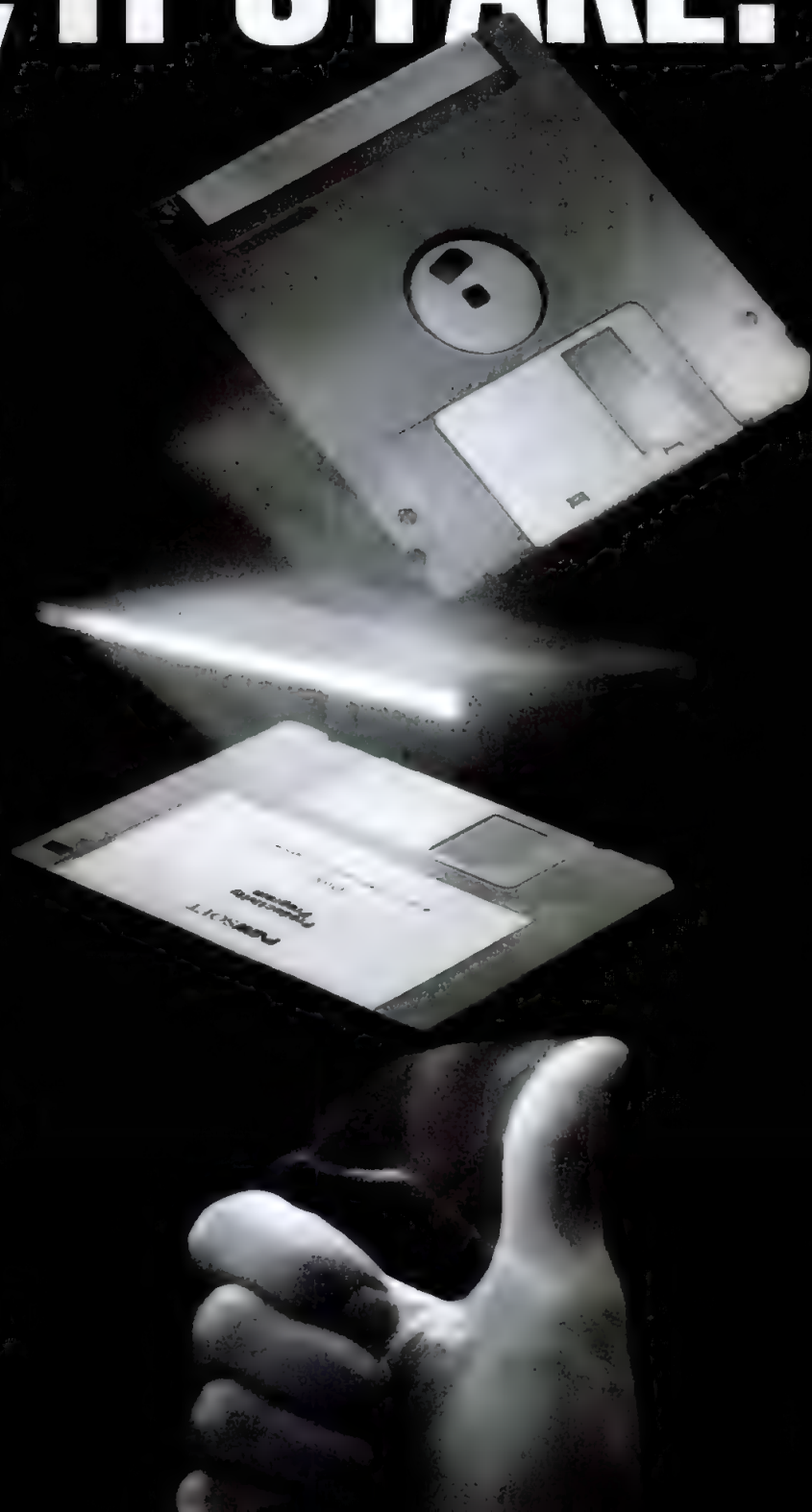
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Reader Service No.	Advertiser	Page
293	3 Com Corporation	46-47
*	Acer America	84
*	Acer America	155-158
226	ADI Systems Inc	62
915	American Power Conversion	NE18-NE19
162	American Power Conversion	325
235	AMS	132-133
336	ARLINGTON COMPUTER PRODUCTS	264
328	Artisoft Inc.	26-27
059	ATI Technologies	320
012	Austin Direct	151-153
049	Bookmaker Inc.	327
292	Caere Corporation	6
*	Canon Computer Systems	306-307
284	Castelle	330
*	Compaq Computer Corporation	70-71
*	Compaq Computer Corporation	106-107
387	CompuLink Research	225
025	CompUSA Direct	250-251
348	Computer Associates	2-3
364	Computer City	247
318	COMPUTER DISCOUNT WAREHOUSE	253
360	COMPUTER DISCOUNT WAREHOUSE	254-255
159	COMPUTER DISCOUNT WAREHOUSE	256-257
076	Connectix	96
369	Connectix	196
044	Corel Corporation	30
332	Corel Corporation	92
322	Corel Corporation	124
037	Corel Corporation	204
041	Corel Corporation	311
042	Corel Corporation	314
314	Corel Corporation	323
358	Corel Corporation	326
011	Corel Corporation	328
286	CTX International	74
*	Dell Computer Corporation	C5-C8
*	Dell Computer Corporation	NE8-NE9
*	Dell Computer Corporation	20-21
*	Dell Computer Corporation	64-65
*	Dell Computer Corporation	68
*	Dell Computer Corporation	216-217
388	Digital Equipment Corp.	52-53
048	Encyclopedia Britannica	316
*	Epson America	10-11
354	Ergo Computing, Inc.	270
014	First Source International	226-227
861	FTP Software, Inc.	NE36

Reader Service No.	Advertiser	Page
005	FTP Software, Inc.	210
*	Gateway 2000	48A-H
*	Gateway 2000	49
*	Gateway 2000	191-194
391/138	H.Co Memory Upgrades	261
062	HARTFORD COMPUTER GROUP	235
881	Hayes Microcomputer Products	NE7
*	Hewlett Packard	78-79
*	Hewlett Packard	81
*	Hewlett Packard	120-121
*	Hewlett Packard	180-181
*	Hewlett Packard-Colorado Memory Systems	28
*	IBM Corporation	42
*	IBM Corporation	123
*	IBM PC Company	14-15
167	Insight Direct	229
219	Insight Direct	230-231
278	Insight Direct	232-233
027	Insight Direct	304
*	Intel Corp.	171-174
034	ITT Sheraton	126-127
383	Janna Systems, Inc.	179
106	Kingston Technology	13
019	L.A. Trade	244
165	Magitronic	245
045	Magix	241
015	Magnavox	167
084	MAXTECH Corporation	319
299	McAfee Associates, Inc.	185
018	MegaHaus	258
*	Megahertz Corp.	114-115
855	Micro Solutions Computer Products	262
122	Micro Solutions Computer Products	322
361	Micrografx	67
214	MicroHelp Inc.	72
924	Micron Electronics	NE2-NE3
119	Micron Electronics	24-25
203	Micron Electronics	88
013	Micron/Zeos Division	109-112
164	Micron Electronics	137-142
*	Microsoft	C2-C4,p1
*	Microsoft	50
010	Midwest Computer Works	242-243
398	Midwest Micro	268
280	Mitsubishi Electronics	35
906	NEC Technologies	NE24
153	NEC Technologies	32-33
157	NEC Technologies	82-83

Reader Service No.	Advertiser	Page
877	NetManage, Inc.	NE11
*	Novell, Inc.	NE14-NE15
232	NuReality	329
892	Octopus Technologies, Inc.	NE28
*	Oracle Corp.	NE5
926	Palindrome	NE32-NE33
*	Palm Computing Inc.	38
*	PC Connection	269
330	PC Mall	259
080	PC Power & Cooling	94
199	PC Zone	248-249
092	PCs Compleat	236-237
268	PCs Compleat	238-239
867	Performance Technology	NE42
148	Primavera Systems	61
039	Princeton Graphic Systems	144
056	Pro Direct	260
884	QMS	NE21
339	Quarterdeck Office Systems	55
338	Quarterdeck Office Systems	57
309	S.A.G./Storage Solutions	58-59
033	Samsung	102
852	Seagate EMS	NE12
871	Seagate Technology	NE27
271	Seagate Technology	187
*	Sony Computer Peripherals	16-17
043	SPSS, Inc.	265
*	STAC Electronics	117
057	Statsoft	41
023	Sun Microsystems	5
887	Sunsoft	NE23
308	Symantec Corporation	18
001	Tektronix Inc.	176
*	TelTrust.COM	NE17
368	Texas Instruments	98-99
246	Texas Instruments	119
379	Toshiba America	86-87
*	Touche	90
051	USA Flex	263
*	Visio	130
085	Winbook Computer Corporation	77
864	Wollongong Group	NE31
163	Xerox Corporation	313
211	Xircom	23
303	ZDI	331
858	Zyxel USA	NE13

Advertisers' Index PRODUCTS

Reader Service No.	Company	Product	Page
ACCELERATOR BOARDS			
059	ATI Technologies	Accelerator Boards	320
ADD-ON BOARDS			
059	ATI Technologies	Accelerator Boards	320
BACKUP SOFTWARE			
915	American Power Conversion	NetShelter	NE18-NE19
162	American Power Conversion	Back UPS Pro	325
892	Octopus Technologies, Inc.	NTFault Tolerance Software	NE28
BOOKS			
048	Encyclopedia Britannica	Encyclopedia Reference Software	316
*	Microsoft	Microsoft Press	50
CD-ROM			
855	Micro Solutions Computer Products	CD-ROM	262
122	Micro Solutions Computer Products	CD-ROM	322
232	NuReality	3D Sound Enhancement	329
CHIPS/PROCESSORS			
391/138	H Co Memory Upgrades	Memory, PCMCIA	261
*	Intel Corp	Intel Tech Series	171-174
106	Kingston Technology	Memory	13
019	L.A. Trade	Memory	244
CO-PROCESSORS			
*	Intel Corp	Intel Tech Series	171-174
COMMUNICATIONS SOFTWARE			
048	Encyclopedia Britannica	Encyclopedia Reference Software	316
299	McAfee Associates, Inc.	WebScan	185
877	NetManage, Inc.	Chameleon	NE11
308	Symantec Corporation	Win 95 - Navigator	18
864	Wollongong Group	Emissary	NE31
COMPUTERS/COMPATIBLES			
*	Acer America	Notebooks	155-158
*	Acer America	Aspire	84
235	AMS	Notebooks	132-133
336	ARLINGTON COMPUTER PRODUCTS	Mail Order, Peripherals	264
012	Austin Direct	Austin Direct Desktops & Notebooks	151-153
*	Compaq Computer Corporation	Desktop Systems	106-107
*	Compaq Computer Corporation	Desktop Systems	70-71
387	Compulink Research	Infinity	225
025	CompUSA Direct	Mail Order	250-251
364	Computer City	Mail Order	247
318	COMPUTER DISCOUNT WAREHOUSE	PCs	253
360	COMPUTER DISCOUNT WAREHOUSE	PCs	254-255
*	Dell Computer Corporation	Dell Desktops and Notebook	C5-C8
*	Dell Computer Corporation	Optiplex	20-21
*	Dell Computer Corporation	Dell Dimension	216-217
*	Dell Computer Corporation	Dell Latitude	64-65
*	Dell Computer Corporation	200 MHz Dell Dimension XPS PRO 200	68
354	Ergo Computing, Inc.	Powerbrick	270
014	First Source International	Memory, Notebooks, Peripherals	226-227
*	Gateway 2000	PCs	191-194
*	Gateway 2000	PCs	48A-H
*	Gateway 2000	PCs	49
062	HARTFORD COMPUTER GROUP	Mail Order	235
*	Hewlett Packard	HP Vectra PCs	78-79
*	Hewlett Packard	HP OmniBook	81
*	IBM Corporation	Apptiva	123
*	IBM PC Company	Client/Server	14-15
167	Insight Direct	Mail Order	229
219	Insight Direct	Mail Order	230-231
278	Insight Direct	Mail Order	232-233
027	Insight Direct	Mail Order	304
165	Magitronic	600 Series	245
045	Magix	Desktop Systems	241
084	MAXTECH Corporation	Monitors, Notebooks, Peripherals	319
164	Micron Electronics	Micron PCs	137-142
203	Micron Electronics	Millenia	88
010	Midwest Computer Works	PCs	242-243
396	Midwest Micro	Desktop Systems	268
153	NEC Technologies	Versa	32-33
*	PC Connection	Mail Order	269
199	PC Zone	Mail Order	248-249
092	PCs Complete	Notebooks	236-237
268	PCs Complete	Notebooks	238-239
309	S.A.G./Storage Solutions	Pentiums, Servers, Storage Solutions	58-59
051	USA Flex	Desktop Systems	263
DATA BASE MANAGERS			
*	Oracle Corp.	Workgroup 2000	NE5
887	Sunsoft	Solars	NE23
DATA CARTRIDGES & FLOPPY DISKS			
348	Computer Associates	Unicenter	2-3
DATA COMPRESSION HARDWARE			
369	Connectix	RAM Doubler for Windows	196
DISK BACKUP & TAPE DRIVES			
122	Micro Solutions Computer Products	Tape Backup	322
826	Palindrome	Seagate Software Family	NE32-NE33
DISPLAYS/MONITORS			
228	ADI Systems Inc	Monitors	62
015	Magnavox	Magnavox Monitors	167
084	MAXTECH Corporation	Monitors, Notebooks, Peripherals	319
010	Midwest Computer Works	Monitors	242-243
280	Mitsubishi Electronics	Monitors	35
157	NEC Technologies	Monitors	82-83
039	Princeton Graphic Systems	Monitors	144
*	Sony Computer Peripherals	Monitors	16-17
EDUCATIONAL SOFTWARE			
322	Corel Corporation	Corel FLOW	124
037	Corel Corporation	Draw 6.0	204
044	Corel Corporation	Xara	30
041	Corel Corporation	Photo CDs - 500	311
042	Corel Corporation	Kids Home Series	314
314	Corel Corporation	Classic Books	323
358	Corel Corporation	Print House	326
011	Corel Corporation	Corel Photo CD	328
332	Corel Corporation	Internet Mania	92

Reader Service No.	Company	Product	Page
EMULATORS/PROTOCOL/CONVERTERS			
*	IBM Corporation	Emulators	42
ENTERTAINMENT SOFTWARE			
322	Corel Corporation	Corel FLOW	124
037	Corel Corporation	Draw 6.0	204
044	Corel Corporation	Xara	30
041	Corel Corporation	Photo CDs - 500	311
042	Corel Corporation	Kids Home Series	314
314	Corel Corporation	Classic Books	323
358	Corel Corporation	Print House	326
011	Corel Corporation	Corel Photo CD	328
332	Corel Corporation	Internet Mania	92
FAX/MODEM			
293	3 Com Corporation	PCA Adapter Cards	46-47
*	Megahertz Corp	XJack PCMCIA V.34 Modem	114-115
163	Xerox Corporation	Xerox Document Work Center 250	313
FLOWCHARTING SOFTWARE			
361	Micrograph	ABC Flowchart	67
*	Visio	Visio 4.0	130
GRAPHICAL INTERFACE			
*	Acer America	Aspire	84
GRAPHICS SOFTWARE			
292	Caere Corporation	OmniPage Pro	6
322	Corel Corporation	Corel FLOW	124
037	Corel Corporation	Draw 6.0	204
044	Corel Corporation	Xara	30
041	Corel Corporation	Photo CDs - 500	311
042	Corel Corporation	Kids Home Series	314
314	Corel Corporation	Classic Books	323
358	Corel Corporation	Print House	326
011	Corel Corporation	Corel Photo CD	328
332	Corel Corporation	Internet Mania	92
*	Visio	Visio 4.0	130
HAND-HELD PC'S			
*	Hewlett Packard	HP OmniBook	81
HARD DRIVES			
167	Insight Direct	Mail Order	229
219	Insight Direct	Mail Order	230-231
278	Insight Direct	Mail Order	232-233
027	Insight Direct	Mail Order	304
018	MegaHaus	Mass Storage	258
056	Pro Direct	Mail Order	260
HARDWARE			
293	3 Com Corporation	PCA Adapter Cards	46-47
235	AMS	Notebooks	132-133
*	Canon Computer Systems	Canon Bubble Jet Printers	306-307
284	Castelle	Personal Fax Printer	330
387	Compulink Research	Infinity	225
078	Connectix	Video Phone	96
*	Dell Computer Corporation	Optiplex	20-21
*	Dell Computer Corporation	Dell Dimension	216-217
*	Dell Computer Corporation	Dell Latitude	64-65
*	Dell Computer Corporation	200 MHz Dell Dimension XPS PRO 200	68
881	Hayes Microcomputer Products	Modems	NE7
*	Hewlett Packard	HP CopyJet Printer	120-121
*	Hewlett Packard	HP SSIMX Network Printer	180-181
*	Hewlett Packard	HP Vectra PCs	78-79
*	Hewlett Packard	HP OmniBook	81
*	IBM PC Company	Client/Server	14-15
167	Insight Direct	Mail Order	229
027	Insight Direct	Mail Order	304
*	Intel Corp	Intel Tech Series	171-174
106	Kingston Technology	Memory	13
165	Magitronic	600 Series	245
045	Magix	Desktop Systems	241
015	Magnavox	Magnavox Monitors	167
018	MegaHaus	Mass Storage	258
*	Megahertz Corp	XJack PCMCIA V.34 Modem	114-115
232	NuReality	3D Sound Enhancement	329
*	Palm Computing Inc.	Personal Organizer/PDA	38
330	PC Mail	Hardware, Software, Peripherals	259
080	PC Power & Cooling	Power Protection/Cooling Devices	94
056	Pro Direct	Mail Order	260
884	QMS	Magickolor CX Laser Printer	NE21
309	S.A.G./Storage Solutions	Pentiums, Servers, Storage Solutions	58-59
001	Tektronix Inc.	Tektronix P550 Color Printer	178
INPUT DEVICES			
379	Toshiba America	Toshiba Touch Pad	86-87
*	Touche	Touche Touch Pad	90
INTEGRATED SOFTWARE			
383	Janna Systems, Inc.	Janna Contact 95	179
INTERNET			
048	Encyclopedia Britannica	Encyclopedia Reference Software	316
861	FTP Software, Inc.	On Net	NE36
005	FTP Software, Inc.	Keyview	210
LABEL/FORM SOFTWARE			
292	Caere Corporation	OmniPage Pro	6
LAPTOP/PORTABLE COMPUTERS			
*	Acer America	Notebooks	155-158
235	AMS	Notebooks	132-133
012	Austin Direct	Austin Direct Desktops & Notebooks	151-153
025	CompUSA Direct	Mail Order	250-251
318	COMPUTER DISCOUNT WAREHOUSE	Notebooks	253
360	COMPUTER DISCOUNT WAREHOUSE	Notebooks	254-255
159	COMPUTER DISCOUNT WAREHOUSE	Notebooks	256-257
286	CTX International	Notebooks	74
*	Dell Computer Corporation	Dell Desktops and Notebook	C5-C8
*	Dell Computer Corporation	Optiplex	20-21
*	Dell Computer Corporation	Dell Latitude	64-65
354	Ergo Computing, Inc.	Powerbrick	270
014	First Source International	Memory, Notebooks, Peripherals	226-227
*	Gateway 2000	Notebooks	191-194
*	Gateway 2000	Notebooks	48A-H
*	Gateway 2000	Notebooks	49
062	HARTFORD COMPUTER GROUP	Mail Order	235
*	Hewlett Packard	HP OmniBook	81

Advertisers' Index PRODUCTS

Reader Service

No.	Company	Product	Page
165	Magitronic	600 Series	245
013	Megahertz Corp.	XJack PCMCIA V 34 Modem	114-115
119	Micron/Zeos Division	Micron Notebooks	109-112
398	Micron Electronics	Home Pro	24-25
153	Midwest Computer Works	Notebooks	242-243
199	Midwest Micro	Notebooks	268
033	NEC Technologies	Versa	32-33
246	PC Zone	Mail Order	248-249
368	Samsung	Samsung Notebooks	102
051	Texas Instruments	TI Notebooks	119
085	Texas Instruments	TI Notebooks	98-99
	USA Flex	Notebooks	263
	Winbook Computer Corporation	Winbook	77

LOCAL AREA NETWORKING

293	3 Com Corporation	PCA Adapter Cards	46-47
284	Castelle	Personal Fax Printer	330
348	Computer Associates	Unicenter	2-3
318	COMPUTER DISCOUNT WAREHOUSE	Networking Products	253
360	COMPUTER DISCOUNT WAREHOUSE	Networking Products	254-255
159	COMPUTER DISCOUNT WAREHOUSE	Networking Products	256-257
062	HARTFORD COMPUTER GROUP	Mail Order	235
	IBM PC Company	Client/Server	14-15
867	Performance Technology	Instant Internet	NE42
309	S.A.G./Storage Solutions	Pentiums, Servers, Storage Solutions	58-59
852	Seagate EMS	Lan Directory	NE12
	STAC Electronics	ReachOut	117

MAIL ORDER

336	ARLINGTON COMPUTER PRODUCTS	Mail Order, Peripherals	264
012	Austin Direct	Austin Direct Desktops & Notebooks	151-153
	Compaq Computer Corporation	Desktop Systems	106-107
387	CompuLink Research	Infinity	225
025	CompUSA Direct	Mail Order	250-251
364	Computer City	Mail Order	247
014	First Source International	Memory, Notebooks, Peripherals	226-227
	Gateway 2000	Mail Order	191-194
	Gateway 2000	Mail Order	48A-H
	Gateway 2000	Mail Order	49
391/138	H Co Memory Upgrades	Memory, PCMCIA, Fax/Modem, LAN	261
	IBM Corporation	Apptiva	123
167	Insight Direct	Mail Order	229
219	Insight Direct	Mail Order	230-231
278	Insight Direct	Mail Order	232-233
027	Insight Direct	Mail Order	304
019	L.A. Trade	Memory	244
165	Magitronic	600 Series	245
045	Magix	Desktop Systems	241
118	MegaHaus	Mass Storage	258
855	Micro Solutions Computer Products	Tape Backup, CD-ROM, Disk Drive	262
119	Micron Electronics	Home Pro	24-25
010	Midwest Computer Works	Mail Order	243
092	PCs Compleat	Notebooks	236-237
268	PCs Compleat	Notebooks	238-239
056	Pro Direct	Mail Order	260

MASS STORAGE

	Hewlett Packard-Colorado Memory Systems	Mass Storage	28
018	MegaHaus	Mass Storage	258
855	Micro Solutions Computer Products	Tape Backup, CD-ROM, Disk Drive	262
122	Micro Solutions Computer Products	Disk Drives	322
309	S.A.G./Storage Solutions	Pentiums, Servers, Storage Solutions	58-59
871	Seagate Technology	Hard Drives	NE27
271	Seagate Technology	AT Drive	187

MEMORY

369	Connectix	RAM Doubler for Windows	196
014	First Source International	Memory, Notebooks, Peripherals	226-227
391/138	H Co Memory Upgrades	Memory	261
106	Kingston Technology	Memory	13
019	L.A. Trade	Memory	244
339	Quarterdeck Office Systems	WinProbe	55

MISCELLANEOUS

049	Bookmaker Inc.	ClickBook	327
	Hewlett Packard	HP CopyJet Printer	120-121
	Hewlett Packard	HP SSIMX Network Printer	180-181
034	ITT Sheraton	ITT Sheraton	126-127
	Microsoft	Microsoft Press	50
379	Toshiba America	Toshiba Touch Pad	86-87
	Touche	Touche Touch Pad	90

MODEMS

293	3 Com Corporation	PCA Adapter Cards	46-47
881	Hayes Microcomputer Products	Modems	NE7
084	MAXTECH Corporation	Monitors, Notebooks, Peripherals	319
	Megahertz Corp.	XJack PCMCIA V 34 Modem	114-115
056	Pro Direct	Mail Order	260
211	Xircom	CIMM	23
858	Zyrex USA	Modems	NE13

MULTIMEDIA

076	Connectix	Video Phone	96
	Epson America	Printers	10-11
062	HARTFORD COMPUTER GROUP	Mail Order	235
855	Micro Solutions Computer Products	Tape Backup, CD-ROM, Disk Drive	262
122	Micro Solutions Computer Products	Tape Backup, CD-ROM, Disk Drive	322
232	NuReality	3D Sound Enhancement	329
330	PC Mail	Hardware, Software, Peripherals	259
	Sony Computer Peripherals	Monitors	16-17

MULTIMEDIA SOFTWARE

025	CompUSA Direct	Mail Order	250-251
322	Corel Corporation	Corel FLOW	124
037	Corel Corporation	Draw 6.0	204
044	Corel Corporation	Xara	30
041	Corel Corporation	Photo CDs - 500	311
042	Corel Corporation	Kids Home Series	314
314	Corel Corporation	Classic Books	323
358	Corel Corporation	Print House	326
011	Corel Corporation	Corel Photo CD	328
332	Corel Corporation	Internet Mania	92
199	PC Zone	Mail Order	248-249

MULTITASKING SOFTWARE

383	Janna Systems, Inc.	Janna Contact 95	179
-----	---------------------	------------------	-----

NETWORK INTERFACE CARDS

211	Xircom	CIMM	23
-----	--------	------	----

Reader Service

No.	Company	Product	Page
NETWORKING SOFTWARE			
328	Artisoft Inc.	LAMastic	26-27
348	Computer Associates	Unicenter	2-3
	IBM Corporation	Emulators	42
892	Octopus Technologies, Inc.	NTFault Tolerance Software	NE28
	Oracle Corp.	Workgroup 2000	NE5
339	Quarterdeck Office Systems	WinProbe	55
338	Quarterdeck Office Systems	QEMM	57
852	Seagate EMS	Lan Directory	NE12
	STAC Electronics	ReachOut	117
887	Sunsoft	Solaris	NE23

ON LINE DATABASE/SERVICES

048	Encyclopedia Britannica	Encyclopedia Reference Software	316
303	ZDI	ZD Net	331

OPERATING SYSTEMS

328	Artisoft Inc.	LAMastic	26-27
887	Novell, Inc.	NDA Partner Camp.	NE14-NE15
	Sunsoft	Solaris	NE23

OPTICAL PERIPHERALS

163	Xerox Corporation	Xerox Document Work Center 250	313
-----	-------------------	--------------------------------	-----

ORGANIZATIONAL SOFTWARE

383	Janna Systems, Inc.	Janna Contact 95	179
	Visio	Visio 4.0	130

PC ACCESSORIES

232	NuReality	3D Sound Enhancement	329
-----	-----------	----------------------	-----

PC DIRECT

336	ARLINGTON COMPUTER PRODUCTS	Mail Order, Peripherals	264
387	CompuLink Research	Infinity	225
025	CompUSA Direct	Mail Order	250-251
364	Computer City	Mail Order	247
318	COMPUTER DISCOUNT WAREHOUSE	Mail Order	253
360	COMPUTER DISCOUNT WAREHOUSE	Notebooks, Desktops, Peripherals	254-255
159	COMPUTER DISCOUNT WAREHOUSE	Mail Order	256-257
354	Ergo Computing, Inc.	Powerbrink	270
391/138	H Co Memory Upgrades	Memory, PCMCIA	261
062	HARTFORD COMPUTER GROUP	Mail Order	235
167	Insight Direct	Mail Order	229
219	Insight Direct	Mail Order	230-231
278	Insight Direct	Mail Order	232-233
027	Insight Direct	Mail Order	304
019	L.A. Trade	Memory	244
165	Magitronic	600 Series	245
045	Magix	Desktop Systems	241
018	MegaHaus	Mass Storage	258
855	Micro Solutions Computer Products	Tape Backup, CD-ROM, Disk Drive	262
010	Midwest Computer Works	Notebooks, Desktops, Peripherals	242-243
398	Midwest Micro	Notebooks, Desktops, Peripherals	268
	PC Connection	Mail Order	269
330	PC Mail	Hardware, Software, Peripherals	259
199	PC Zone	Mail Order	248-249
092	PCs Compleat	Notebooks	236-237
268	PCs Compleat	Notebooks	238-239
056	Pro Direct	Mail Order	260
043	SPSS, Inc.	Statistical & Windows Software	265
051	USA Flex	Notebooks, Desktops, Peripherals	263

PCMCIA

391/138	H Co Memory Upgrades	Fax/Modem, Flash, SRAM Drives	261
	Megahertz Corp.	XJack PCMCIA V 34 Modem	114-115
211	Xircom	CIMM	23

PERIPHERAL SHARING DEVICE

881	Hayes Microcomputer Products	Modems	NE7
-----	------------------------------	--------	-----

PERIPHERALS

293	3 Com Corporation	PCA Adapter Cards	46-47
059	ATI Technologies	Accelerator Boards	320
318	COMPUTER DISCOUNT WAREHOUSE	Peripherals	253
360	COMPUTER DISCOUNT WAREHOUSE	Peripherals	254-255
159	COMPUTER DISCOUNT WAREHOUSE	Peripherals	256-257
	Epson America	Printers	10-11
014	First Source International	Memory, Notebooks, Peripherals	226-227
	Gateway 2000	Peripherals	191-194
	Gateway 2000	Peripherals	48A-H
	Gateway 2000	Peripherals	49
881	Hayes Microcomputer Products	Modems	NE7
	Hewlett Packard	HP CopyJet Printer	120-121
	Hewlett Packard	HP SSIMX Network Printer	180-181
015	Magnavox	Magnavox Monitors	167
084	MAXTECH Corporation	Monitors, Notebooks, Peripherals	319
122	Micro Solutions Computer Products	Tape Backup	322
398	Midwest Micro	Peripherals	268
232	NuReality	3D Sound Enhancement	329
330	PC Mail	Hardware, Software, Peripherals	259
199	PC Zone	Mail Order	248-249
092	PCs Compleat	Notebooks	236-237
268	PCs Compleat	Notebooks	238-239
884	QMS	Magicolor CX Laser Printer	NE21
001	Tektronix Inc.	Tektronix P550 Color Printer	176
379	Toshiba America	Toshiba Touch Pad	86-87
	Touche	Touche Touch Pad	90
051	USA Flex	Peripherals	263
163	Xerox Corporation	Xerox Document Work Center 250	313

POWER PROTECTION

915	American Power Conversion	NetSheller	NE18-NE19
162	American Power Conversion	Back UPS Pro	325
080	PC Power & Cooling	Power Protection/Cooling Devices	94

PRESENTATION SOFTWARE

	Microsoft	Microsoft Office	C2-C4,p1
--	-----------	------------------	----------

PRINTER ACCESSORIES

284	Castelle	Personal Fax Printer	330
001	Tektronix Inc.	Tektronix P550 Color Printer	176

PRINTERS

	Canon Computer Systems	Canon Bubble Jet Printers	306-307
	Epson America	Printers	10-11
	Hewlett Packard	HP CopyJet Printer	120-121
	Hewlett Packard	HP SSIMX Network Printer	180-181
884	QMS	Magicolor CX Laser Printer	NE21
001	Tektronix Inc.	Tektronix P550 Color Printer	176

Advertisers' Index PRODUCTS

Reader Service

No.	Company	Product	Page
051	USA Flex	Printers	263
163	Xerox Corporation	Xerox Document Work Center 250	313

PROGRAMMERS TOOLS UTILITIES

348	Computer Associates	Unicenter	2-3
-----	---------------------	-----------	-----

PROJECT MANAGEMENT SOFTWARE

148	Primavera Systems	Suretrak	61
-----	-------------------	----------	----

REMOTE COMPUTING

*	Hewlett Packard	HP OmniBook	81
299	McAfee Associates, Inc.	WebScan	185
*	STAC Electronics	ReachOut	117
308	Symantec Corporation	Win 95 - Navigator	18

RESELLERS

159	COMPUTER DISCOUNT WAREHOUSE	Reseller	256-257
010	Midwest Computer Works	Reseller	242-243

SCANNERS

*	Canon Computer Systems	Canon Bubble Jet Printers	306-307
163	Xerox Corporation	Xerox Document Work Center 250	313

SECURITY

*	TelTrust.COM	dot Net	NE17
---	--------------	---------	------

SERVERS

012	Austin Direct	Austin Direct Desktops & Notebooks	151-153
284	Castelle	Personal Fax Printer	330
*	Dell Computer Corporation	Dell Servers	NE8-NE9
388	Digital Equipment Corp.	Servers	52-53
*	IBM PC Company	Client/Server	14-15
924	Micron Electronics	Micron Servers	NE2-NE3
906	NEC Technologies	RISC Servers	NE24
309	S.A.G./Storage Solutions	Pentiums, Servers, Storage Solutions	58-59
*	STAC Electronics	ReachOut	117

SERVICE/SUPPORT

084	MAXTECH Corporation	Monitors, Notebooks, Peripherals	319
*	TelTrust.COM	dot Net	NE17

SOFTWARE

328	Artisoft Inc.	LANtastic	26-27
369	Connectix	RAM Doubler for Windows	196
*	IBM Corporation	Emulators	42
299	McAfee Associates, Inc.	WebScan	185
361	Micrografix	ABC Flowchart	67
214	MicroHelp Inc.	Uninstaller	72
*	Microsoft	Microsoft Office	C2-C4 p1
877	NetManage, Inc.	Chameleon	NE11
*	Oracle Corp.	Workgroup 2000	NE5
148	Primavera Systems	Suretrak	61
043	SPSS, Inc.	Statistical & Windows Software	265
308	Symantec Corporation	Win 95 - Navigator	18
*	Visio	Visio 4.0	130

SPREADSHEET/TEMPLATES

*	Microsoft	Microsoft Office	C2-C4 p1
---	-----------	------------------	----------

STATISTICAL SOFTWARE

043	SPSS, Inc.	Statistical Software	265
057	Statsoft	Statistical Software	41

TCP/IP

877	NetManage, Inc.	Chameleon	NE11
864	Wollongong Group	Emissary	NE31

TELECOMMUNICATIONS

*	TelTrust.COM	dot Net	NE17
---	--------------	---------	------

TIME MANAGEMENT SOFTWARE

383	Janna Systems, Inc.	Janna Contact 95	179
-----	---------------------	------------------	-----

TRAINING SOFTWARE

*	Microsoft	Microsoft Press	50
---	-----------	-----------------	----

TRAINING/SEMINARS/CONFERENCES

*	Microsoft	Microsoft Press	50
---	-----------	-----------------	----

UTILITIES

214	MicroHelp Inc.	Uninstaller	72
339	Quarterdeck Office Systems	WinProbe	55
338	Quarterdeck Office Systems	QEMM	57

WINDOWS SOFTWARE

348	Computer Associates	Unicenter	2-3
369	Connectix	RAM Doubler for Windows	196
383	Janna Systems, Inc.	Janna Contact 95	179
299	McAfee Associates, Inc.	WebScan	185
361	Micrografix	ABC Flowchart	67
214	MicroHelp Inc.	Uninstaller	72
*	Microsoft	Microsoft Office	C2-C4 p1
*	Microsoft	Microsoft Press	50
877	NetManage, Inc.	Chameleon	NE11
330	PC Mail	Hardware, Software, Peripherals	259
148	Primavera Systems	Suretrak	61
043	SPSS, Inc.	Windows Software	265
*	STAC Electronics	ReachOut	117
057	Statsoft	Windows Software	41
*	Visio	Visio 4.0	130
864	Wollongong Group	Emissary	NE31

WORKSTATION SOFTWARE

*	Hewlett Packard	HP Vectra PCs	78-79
023	Sun Microsystems	Ultra Sparc Workstation	5

For Additional Categories see MARKETPLACE PRODUCT INDEX Page 271



Coming Up

Create Your Own CD!

Just a year ago, making your own CD-ROM was out of the question for most PC users. The software and hardware were difficult even for experienced computer users to work with, and out of the financial reach of most. Not any more! CD creation is edging toward the mainstream, with more user-friendly software and lower prices. In this issue we present several stories aimed at getting you up and running.

Multimedia Authoring

Since many corporations now distribute interactive multimedia, they need tools to help them create their own CD-ROMs. Today's multimedia authoring software offers seamless graphical user interfaces as well as tools for kiosk creation, computer-based training (CBT), and Web publishing. We review nine multimedia authoring software products, examine how well they work for experts and neophytes, and help you pick one to create your own fluid multimedia. Extra: a behind-the-scenes peek at how we create our CD-ROM version of *PC Magazine*.

CD-R Drives

Now that you've organized the content, you're ready to commit the data to disk. We review 18 compact disk-recordable drive bundles—some under \$1,000—that provide the hardware and software needed to burn custom CD-ROMs. Find out which are suited to professional-caliber CD creators and which are aimed at those who need CD-R technology only occasionally.

CD-ROM Mastering Tools

CD-R devices almost invariably ship with CD mastering software, but you often get a "lite" version designed to cover just the basics. The full-blown package may cost hundreds more, but it holds out the promise of additional features and broader functionality. PC Tech reviews leading standalone CD-ROM mastering packages to find out what you get for the additional investment and whether it's worth the price.

Customizable Online News

Care about sports but not politics? Or vice versa? The online revolution has spawned numerous ways to tailor news to your interests. We examine a varied crop of services that cost under \$50 a month. You specify your interests; the services then e-mail you news stories or update your personal Web page. We also briefly look at multi-thousand-dollar corporate solutions on the high end and free personalized Web newspapers on the low.

Editorial Product Index

Reader Service No.	Product	Company	Page
401	Apcon ACI-2016 SCSI Booster	Apcon Inc.	66
426	Bravo MS-T 6150	AST Research Inc.	76
453	Britannica CD	Encyclopedia Britannica Inc.	309
955	Call Link for Windows	Teledata Solutions Inc.	NE37
418	CharacterEyes Pro for Networks	Ligature Software Inc.	75
409	Citizen Printiva 600C	Citizen America Corp.	69
415	ClarisDraw 1.0 for Windows	Claris Corp.	75
412	ClarisWorks 4.0	Claris Corp.	39
402	Compadre	Three D Graphics	66
447	Compaq ProLiant 1500 5/133	Compaq Computer Corp.	159
454	Compton's Interactive Encyclopedia, 1996 Edition	Softkey International Inc.	310
952	Cruiser	Connectware Inc.	NE29
448	Dell PowerEdge XE 133-2	Dell Computer Corp.	162
449	Digital Prioris HX 5166	Digital Equipment Corp.	166
455	Encyclopedia Americana	Grolier Interactive	312
956	Gauntlet Internet Firewall, Version 3.1	Trusted Information Systems Inc.	NE37
435	HP Color LaserJet 5M	Hewlett-Packard Co.	40
450	HP NetServer 5/133 LH	Hewlett-Packard Co.	170
433	HP ScanJet 4p	Hewlett-Packard Co.	60
424	HP Vectra VL4	Hewlett-Packard Co.	76
431	HTML Transit	InfoAccess Inc.	76
458	IBM Database 2 for Windows NT 2.1	IBM Corp.	190
451	IBM PC Server 320	IBM Corp.	178
405	Incredible Sound	Philips Key Module	63
953	Internet Junction	Cisco Systems Inc.	NE37
441	Internet Wave 1.0	VocalTec Inc.	108
452	IPC Affinity XE	IPC Technologies Inc.	182
421	KidSecure for Windows 95	Alpha Software Corp.	80
403	Labtec Imager	Labtec	63
437	LapLink for Windows 95	Traveling Software	48
420	microLaser WIN/4	Texas Instruments Inc.	80
417	Micron Millennia TransPort	Micron Electronics Inc.	75
456	Microsoft Encarta 96 Encyclopedia	Microsoft Corp.	318
959	Multicruise	Zenith Data Systems	NE38
407	MultiSync LCD200	NEC Technologies Inc.	69
429	M.Y.O.B. Accounting Version 6.0	Best!Ware	80
428	Net Toob	Duplexx Software Inc.	76
408	Neural Connection 1.0	SPSS Inc.	51
455	1996 Grolier Multimedia Encyclopedia	Grolier Interactive	324
436	Norton pcAnywhere 32 for Windows	Symantec Corp.	48
434	150-MHz Pentium OverDrive processor	Intel Corp.	54
410	One-Write Plus Version 5.0 for Windows	NEBS Software	45
411	Painter 4	Fractal Design Corp.	45
422	Parental Guidance	Providence Systems	80
414	Partition Magic	PowerQuest Corp.	56
406	PC411 for Windows 1.1	PC411 Inc.	51
430	Peachtree First Accounting Release 2.0	Peachtree Software	80
951	PhoneWorks 14.4	Connectware Inc.	NE30
951	PhoneWorks 28.8	Connectware Inc.	NE30
954	Pipeline 130	Ascend Communications Inc.	NE37
958	Pronto Mobile	CommTouch Software Inc.	NE38
958	Pronto Secure	CommTouch Software Inc.	NE38
442	RealAudio 2.0	Progressive Networks Inc.	113
957	StackMaster TR	Transition Networks Inc.	NE38
443	StreamWorks	Xing Technology Corp.	118, 134
413	SuperPrint 4.0	Zenographics	56
445	ToolVox for the Web	VoxWare Inc.	122
419	Total Recall	Sycom Technologies Inc.	80
444	TrueSpeech Internet	The DSP Group Inc.	125
416	United Connection	United Airlines Corp.	75
446	VDOLive	VDOnet Corp.	136
961	Virtual Desk PC	ImageLink Inc.	NE29
404	Vivid3D Proex	NuReality	63
432	Web 3D	Asymetrix Corp.	75
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425	Z-Station GT	Zenith Data Systems	76

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Abort, Retry, Fail?

THE LIGHTER SIDE OF PERSONAL COMPUTING

By Don Willmott

Classified Intelligence

"Seeking Employment: I told the boss I wouldn't marry his daughter because she was ugly. So now I'm looking for another job. If you need a good programmer, . . . or if you just want to vent your spleen, call Larry."—*COMPUTING NEWS AND REVIEW*

"For sale: Apple IIC+ computer. Color monitor, games. Good for starters. Also African Hedgehog. Will sell for \$200."—*THE EAST PENNSYLVANIA MERCHANDISER*

The newest  arrival at the Department of Unfortunate

Acronyms: "cross-bridge reconfigurable array of processors." (*IEEE Transactions on Parallel and Distributed Systems.*)

A. Parallel Selection Algorithm on a CRAP

In this section, we will present a parallel algorithm for the selection problem to determine the k th smallest element in a sequence SQ of n integers.

A Mickey Mouse Mouse Lesson

"To use the right mouse button, do the same as for the left, except click the right mouse button instead of the left."—*PEACHTREE ACCOUNTING FOR WINDOWS DOCUMENTATION*



"I don't care if you do have a coalition of kids from 19 countries backing you up; I'm still not buying you an ISDN line."

System Requirements:

- Intel 486 or compatible CPU
- PCI 2.0 or VL-Bus 2.0 compliant mother board and available sloth
- MS-DOS 5.0 or later or compatible for DOS utilities.

 Will a three-toed sloth do, or does it have to be four-toed? (Diamond Multimedia box.)

★ Administrative

90

ADMINISTRATIVE POSITION
College of Applied Science and Technology - Department of Computer and Information Sciences - Systems Manager - Level 12. Position will provide technical and systems support to Computer Science faculty, staff and students, and will supervise - 30 student workers and technical graduate assistants. Position will be responsible for two computer laboratories containing a wide variety of software and hardware. The holder of this position must be self-motivated, be able to work independently, be highly organized, and require very minimal supervision. **Essential Functions:** this position reports to the Chair of the Department of Computer and Information Sciences and will be responsible for evaluation and implementation of emerging computing technologies as they relate to an academic, research-oriented setting; perform operating system installation, customization, account maintenance, and security on a variety of platforms; act as a liaison with Computer Services and contracted support organizations; provide help desk services and in-service workshops; manage and evaluate student workers and supervise technical GA research work; provide accounting for lab use; manage departmental budget related to software and hardware acquisition, maintenance contracts, and computer supplies. **Qualifications:** candidates must minimally have a bachelor's degree in Computer Science and at least two years system management experience in administering VMS, UNIX, OS/2, and Netware file servers and VMS, OS/2, Windows, DOS clients in an academic environment; must be conversant with networking protocols (including TCP/IP, DECnet, IPX, and SNA), topologies (both token-ring and ethernet), and applications (especially OS/2 Communications Manager/2); prior experience with OS/2 multi-protocol support (NTS/2) critical; must have experience in computer/network hardware installation, configuration, and problem determination of IBM PS/2s and IBM/Digital high-end servers/workstations; must possess excellent interpersonal and supervisory skills; must be able to train others at a variety of skill levels; experience with software specific to computer science research including CASE tools, modeling and simulation tools, Internet servers and clients, parallel architectures, real-time applications, X/Motif, and the APIs of various operating systems preferred. Review of applications will begin immediately and continue until the position is filled. Submit application to Office of Human Resources, ETSU, Box 70644, Johnson City, TN 37614-0644. AA/EOE.

 Is this the longest help-wanted ad in the history of newspapers? It's interesting to note that nowhere is the small matter of the salary mentioned. (Knoxville News-Sentinel.)



 ARF on the road: Rochester, New York. Looks as if the LAN isn't the only vacant thing around there.

If your entry is used, we'll send you \$50 and a PC Magazine T-shirt. Send your entries to Abort, Retry, Fail?, PC Magazine, One Park Ave., New York, NY 10016-5802. Winners this issue: Carson Booth, Doug Burger, Reid Davis, Ken Kathan, Sal Mengine, Roy Roddy, and Frank Smith.

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*Tests conducted by the National Software Testing Laboratories, a division of McGraw-Hill, Cos. Published in Business Week, November 6, 1995.